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RATES FOR TRANSMITTED WATER POWER.

The subject of power rates is one of vast scope. In central-station work no inconsiderable portion of the time of the manager is likely to be devoted to explaining and perhaps justifying the rates in force at any given period, and in spite of the attention paid to the problem and the understanding of it attained by a few exceptional men, standardization of methods of charging for power service from central stations is still a long distance away. In the field of electrically transmitted water power there are many discrepancies between the practices of companies in different places, and from the aspect of the consumer, it appears that there is frequently inability to see why the cost of such service should vary so widely when reduced to the basis of the kilowatt-hour.

It is unnecessary to cite examples of the differing rates for service supplied to communities by distant water-power plants, for the matter is almost common knowledge. There is, however, an advantage in looking at some of the strong and some of the weak points in power prices, or rather methods of establishing them, on systems where waterfalls are an important dependence of the operating company. Just as the purchaser of electricity who represents a national or perhaps a state organization complains to local central stations because the cost to him of a similar service in different cities and towns is often apparently inconsistent, so does the buyer of transmitted water power approach the large company with off-hand comparisons of what prices he has to meet elsewhere. It is not always enough for the large power purveyor to make the prospective consumer a price which will save him money over the existing cost of operating his machinery by the older methods; he must be prepared to show to some extent at least why the manner of charging may fairly differ from the practice of the steam plant in the city, and now and then he may be called upon to sustain such a feature of his own charges as the flat rate or initial stated charge against the meter system of billing.

At the present stage of things it would be difficult to prove that any given system of charging for water power distributed by electrical methods is incomparably better than any other. Both the flat rate and the meter systems have their advocates, and there is no question that companies make money under both plans. Before touching upon these phases of the problem, however, it is of no little

importance to urge the practice of a wider publicity of rates than sometimes obtains in the transmission business. True as it is that many companies are carrying on their books old contracts which appear to be discriminatory when judged by the standards of today, it none the less remains a fact that the publication of an open schedule of rates and a strict adherence to it in signing subsequently connected loads will accomplish wonders in disarming popular distrust of prices. Most men are disposed to be reasonable when frankly informed the reason for maintaining old contract rates, and it is still surprising how many companies are handicapped to some extent by agreements of long life which were made in the days when new business was secured only by desperate struggles. Only a little while since it was shown in a hearing in New York that one of the most responsible companies in the central-station field was at the time selling current at special rates to upwards of fifty customers whose contracts were inherited from its predecessors. When the facts came out, very little trouble followed. If the public only knew it, the accounting difficulties of carrying a few consumers along on a special rate make so much trouble for the average company that if it were not for the inviolability of the contract, short work would be made of the abnormal relations existing between the company and its exceptional patrons of the foregoing type.

The water-power transmission company is more concerned with the peak load which its investment must handle than with the average demand of its consumers. This makes an initial charge on the basis of connected installation of more importance in many cases than the subsequent price per unit consumed. Few people appreciate the controlling influence of the readiness-to-serve element in a water-power system. The first cost in such undertakings is so important that the annual charges upon the investment exceed the operating charges. The cost of labor is the other great item and to a large extent this also is more independent of the load at any hour than in a corresponding steam plant. It seems pretty clear that the first duty of such a company is to make itself whole so far as fixed and labor charges are concerned, and this generally resolves itself into either a flat rate per unit of connected load per month or year, or to a charge based upon the maximum demand of the installation, and determined either by special test or by a curve-drawing meter. The usefulness of the latter is only beginning to be appreciated in the larger field of water-power sales. Another thing which will in the future receive more attention is the relation of such small points as the spacing of dangerous wires in station buildings to the first cost of the plant; the relation between the arrangement of equipment and the labor cost; and the influence of proper lighting upon the economy of service. The combination of a fixed charge with a meter charge offers a middle course which is worth bearing in mind on systems where varied schedules or different ways of reaching a given revenue scale are desirable.

CONVENTION OF THE AMERICAN ELECTROCHEMICAL SOCIETY.

The convention of the American Electrochemical Society which was held last week at Toronto, Canada, will be looked back upon by all those who were fortunate enough to attend, as one of the pleasantest which the Society has yet held. The arrangements made by the committee for the entertainment of the members and visitors were very complete and gave a chance for Toronto hospitality to make a very favorable impression upon all those participating.

The range of subjects covered by the papers presented was large, perhaps even larger than usual. This tendency in the meetings of the American Electrochemical Society has always been pronounced and undoubtedly adds much to the general interest of its meetings since they appeal not only to a single line of specialists but those whose interests are much wider. It is not our intention here to discuss the individual papers, abstracts of which will be found elsewhere in this issue. One fact, however, which was prominently brought out at this meeting was the great progress which is being made in the application of electric current to the reduction of iron ore and to the fixation of atmospheric nitrogen.

These developments depend very largely upon the possibility of obtaining cheap power and naturally they are proceeding most rapidly in those places where this condition can be met. Norway and Sweden, particularly the former, may be regarded as leaders in this direction. It is stated that electrical power can be generated from waterfalls in the latter country with an initial investment of from $20 to $30 per horsepower. Since fixed charges are one of the largest elements of power cost in hydroelectric projects this constitutes a very important element in the cheapening of power. When we contrast these figures with the installations in this country such as at Niagara Falls where the investment is not less than $100 per horsepower it can be readily understood what great advantages exist in Norway for the applications of electric power under consideration. There is already being applied in Norway 240,000 horsepower in the fixation of atmospheric nitrogen. It is hard to grasp the significance of these large figures, but everyone must be impressed with the fact that this constitutes a very large industry and is no longer a matter of experimental development. Two processes are mainly in use, the Schoenherr and the Birkeland-Eyde, the former having shown its greater suitability in small units, whereas the latter is most suitable for development in large units. In an article which appeared in these columns two weeks ago will be found a discussion of these different processes.

The electric smelting of iron ore is another great industry which has passed the experimental stage and is beginning to assume large proportions. The experimental furnace which has been in operation at Trollhattan during

the past year has proven the suitability of this method both as regards cost of operation and quality of output. A discussion of these experiments was given by Mr. Robertson at the meeting and the report of the engineers will be found abstracted in our last issue. There are already, however, other plants in operation and projected in both Norway and Sweden and we may expect to see a large industry built up on the electric-furnace process.

The conditions in Canada resemble those in the Scandanavian peninsula more closely than those in any other country. Large water powers are available with the development of electrical energy, iron ore is present in large quantities, and moreover the conditions are not suitable for ordinary blast-furnace smelting. In the first place coke is scarce and in the second place the ores contain titanium whose presence is practically prohibitive of the use of this ore in the blast furnace. It has been materially demonstrated, however, that titaniferous ores can be successfully smelted in an electric furnace and also that it is possible to handle finely divided concentrates. There is reason to expect, therefore, that we may look for a development of this industry in Canada also.

TIMELY WINDOW DISPLAYS.

At this time of the year, when with the change of seasons there is a change of window displays in nearly all the retail commercial houses, there are many points that may be overlooked by the smaller and medium-sized retail electrical stores. The importance of keeping a timely display in the window, changing it often and arranging it with thoughts of attractiveness is not always fully realized.

Just now, although there may be a few more warm days, it would seem more advisable to turn the attention of the public to such devices as radiant heaters, chafing dishes, etc., with appropriate reference in the first case to the chill mornings which are coming on and in the latter to the evening parties and suppers which will soon be again in order. Seasonable window dressing is not always carried out at present and often where it is done, it is not carried out in such a way as to leave a pleasant impression. Many windows are a mass of electrical toys, switches and dusty looking fans from one month to the next. Order and system are too often lacking, and from the cause, doubtless, that the value of the window space is not appreciated.

Of course this does not apply to the larger stores or the stores kept by the larger lighting companies, but it does seem to be the case in the contractors' stores, which in number at least are in the great majority. It is a condition that will change only at such time as the modern retailing methods of other up-to-date stores are more carefully observed and more closely followed. There must be a realization that the electrical business has not laws peculiar to itself but that the demand must be built up in the same way as it is in any other commercial line.

THE ILLUMINATING ENGINEERING SOCIETY'S CONVENTION.

The fifth annual convention of the Illuminating Engineering Society, which at this writing, is being held in Chicago, is in many respects the most noteworthy gathering this organization has yet held. It is the first convention of the Society ever held in the West and its stimulating influence on the large membership in this part of the country is bound to be marked. It doubtless will increase the prestige of the Society throughout the large territory tributary to its Chicago Section. The attendance at the convention is not only larger than that at most of the previous gatherings, but it is more representative in many ways.

The Convention Committee deserves praise for the excellent balance of the general program. There is not an excess of entertainment features nor other distractions from the more serious business of the gathering. The program is not so crowded as to necessitate departure from its schedule or curtailment of the discussions. This is an admirable feature in any convention because it achieves what the convention is for, namely, free interchange of ideas from many viewpoints on all topics considered. Where a program is so congested as to necessitate only brief presentation and discussion of the papers, those in attendance at the convention receive little more benefit than those reading the papers at home.

Respecting the papers being presented, most of which are abstracted in another part of this issue, it may be said that while many are of high merit and general interest, others as usual are of but ordinary value, while a few might better have been entirely left out because they were of a severely commercial character and introduced scarcely any new facts. One paper, in particular, may be characterized as merely a rehash of catalog information. How this passed by the vigilance of the Paper's Committee is difficult to explain, unless it was through hypnosis. At any rate the introduction of this feature into a national organization that has made almost desperate efforts to bar it out is unfortunate. Nothing is to be gained by a rediscussion of exploded arguments.

Despite light eruptions here and there, the present convention has shown that the Illuminating Engineering Society is founded on a broad and permanent basis, that is, has an important mission to perform, that it has done its best, considering its youth, in performing that mission, and that there is an ever broadening sphere of activity open to it. Some of the speakers at the convention have pointed out several lines of work that the Society may well undertake with dignity. One of these is to consider more deeply than in the past the art of illumination. Another is to evolve standardization rules and to compile what there is general agreement on in the knowledge of illuminating engineering. Still another is to establish more sections and thus provide for greater dissemination of the gospel of good lighting in all parts of the country.

International Municipal Congress and Exposition.

In connection with the International Municipal Congress and Exposition, held at the Coliseum, Chicago, September 18 to 30, there was shown a large display of exhibits pertaining particularly to material, machinery and equipment that enters into the construction and operation of a modern city.

Of electrical interest were the exhibits of the electrical department of the city of Chicago and of the city of New York. The former, under the auspices of the Electrical Inspection Bureau, compared modern wiring practice with the hazardous electric-wiring, not antiquated. In the New York exhibit is displayed a series of photographs showing the evolution of the lamp-post dating back to 1850. Illustrations of typical modern street illumination are also on exhibition.

The exhibits of the Commonwealth Edison and North Shore Electric companies are of most interest, electrically, among the many industrial exhibitions. As announced in these columns, September 16, the Edison company displayed a large map of Chicago indicating the location of its generating and substations by different-colored incandescent lamps. The exhibit of the North Shore Electric Company was of a similar nature.

Robert W. Hunt & Company, of Chicago, showed interesting inspection tests on wire. The Western Gas Construction Company, of Fort Wayne, exhibited attracive ornamental standards for street lighting. The H. W. Johns-Manville Company, of New York, showed, among other things, an asbestos booth for moving-picture machines. The McCrum-Howell Company, Monarch Vacuum Cleaner Company and the Palm Vacuum Cleaner Company showed electric vacuum-cleaning plants. Among other exhibitors of electrical appliances are: The Arnold Company, Chicago; H. M. Byllesby & Company, Chicago; Green Engineering Company, Chicago, and the Dean Electric Company, Elyria, Ohio.

The sessions of the congress, held each day, were devoted to discussions of subjects pertaining to municipal economy, progress and perfection. Monday, September 25, was given over to a discussion of public-utility problems. Bion J. Arnold was chairman of this meeting and the principal address was made by Henry M. Byllesby of Chicago. Addresses were also made by E. L. Elliott and E. W. Bemis of New York.

Illinois State Electric Convention.

The convention of the Illinois State Electric Association will be held at Rockford, Ill., October 24, 25 and 26. An interesting program will be carried out, and arrangements have been made for a number of special papers. Details regarding the convention may be secured from H. E. Chubbuck, secretary, Peoria, Ill.

National Mine Safety Demonstration.

At the National Mine Safety Demonstration which will take place in Pittsburgh, Pa., October 30 and 31, some exhibitions of interest from an electrical standpoint will be given. One of these trials will show the effect of breaking lighted incandescent lamps which are surrounded by an explosive mixture of gas and air.

A test of a mine motor surrounded by an explosive mixture of gas and air and provided with explosion-proof protective devices, will be made, and a second test will show the effect of removing this device.

Meeting of Chemical Engineers.

The fourth annual meeting of the American Institute of Chemical Engineers will be held in Washington, D. C. December 20 to 22. A number of papers will be presented on the general subject of patents, and the manufacture and testing of explosives as well as a number of other chemical engineering subjects. One day will probably be devoted to visits to the technical chemical engineering plants in Baltimore and vicinity. Visits to laboratories and other points of interest in Washington will also be arranged for.

Block-Signal Committee Meets.

Members of the Block-Signal Committee of the interurban roads of Indiana held a conference in Indianapolis on September 23 with the Railroad Commission of the state, to discuss the progress that is being made in the way of signal installations on the railways. A. W. Brady, Will Irwin, C. L. Henry and R. I. Todd represented the committee

A conference between the two bodies will be held again on October 27.

Chicago Electric Club.

L. B. Marks, consulting engineer of New York, addressed the Chicago Electric Club on Wednesday, September 27, choosing for the subject of his remarks the attitude of the United States Government towards illuminating engineering.

A large number of delegates to the convention of the Illuminating Engineering Society, which was held in Chicago during the week of September 25, were present to greet Mr. Marks, who was the first president of that Society, and the meeting was a notable one in every respect.

Mr. Marks spoke forcibly of the very poor interior lighting of public buildings coming under the jurisdiction of the Treasury Department. He said that it was a significant fact that no person charged with the responsibility of lighting the interior of our public buildings was a member of the Illuminating Engineering Society. All efforts made to present the matter of scientific lighting before the treasury officials have been unsuccessful and Mr. Marks appealed to the club to consider the matter and use its influence to remedy the present undesirable conditions.

E. L. Elliot, of New York, spoke of the modern illumination of the two new office buildings of the capitol, in Washington, and also referred to the improved lighting in parts of the capitol. These, however, do not come under the jurisdiction of the Treasury Department.

F. J. Pearson said that the undesirable conditions that obtain in illumination obtain in all other branches of engineering. This due, perhaps, to the fact that the office of supervising architect is a political one and he said no change can be hoped for until the supervising architect is appointed for his engineering ability and is empowered to utilize the best methods in all engineering work.

L. B. Marks, in closing, said that in comparison with the poor illumination of public buildings controlled by the Treasury Department, the approved illumination in the State, War and Navy Department Building, the National Museum, the new wing of the Library of Congress and the Army and Navy Club Building, is noteworthy. These latter public buildings do not come under the Treasury supervision. A vote of thanks was tendered the speakers.

Frederic Nicholls.

There is no other individual who is responsible to such a great extent for the present electrical development of Canada as Frederic Nicholls, president, vice-president or director of thirty of the largest manufacturing and commercial companies in the Dominion.

Frederic Nicholls was born in England, November 23, 1856. He received his early education at Stuttgart, Wurtemburg, and in 1874 crossed the Atlantic for Canada in search of the wider field for which he was specially adapted. His early connection with politics and journalism and his keen and helpful interest in tariff matters are well remembered facts in Canadian history.

FREDERIC NICHOLLS.
Canadian Electrical Promoter.

In electrical matters he will be gratefully remembered as an active pioneer with unbounded faith in electricity and electrical Canada. He was the means of organizing the first incandescent lighting system in Canada; was keenly interested in the promotion of the first street-railway system; was entirely responsible for the fact that the Canadian General Electric Company has held a most prominent place in Canadian electrical manufacturing for the past three decades; has been largely instrumental in the promotion of two of the finest interurban electric railway systems in the Dominion; and finally is chiefly responsible for one of the finest hydroelectric development systems in the world, the Electrical Development Company's plant at Niagara Falls and its subsidiary eighty-five-mile transmission line to Toronto.

In all of these enterprises Mr. Nicholls has been a prominent figure, in addition to which his interest in electrical matters led him to associate himself with other Canadians in the large Sao Paulo consolidation, and later with the Rio de Janeiro system.

A noteworthy feature in connection with the various enterprises that owe their origin to Mr. Nicholls is the relation that each holds to the other, the whole forming a chain of correlated developments. The Toronto Incandescent Company was first established to supplement arc lighting; the underground system of distribution to further the incandescent house system; the generation of electric power to supply the lighting system; the manufacture of electrical supplies for use in the generation, distribution and consumption of his electric power; the promotion of street railways for the utilization of more power; the Niagara Falls development to supply the growing power requirements, and, finally, the organization of the Canada Foundry for the supply of the various forms of metal required in the manufacture, transmission and utilization of all this energy.

That the business men of Canada have confidence in his judgment and executive ability is indicated by the position he occupies in the various companies with which he is interested. He is vice-president and managing director of the Electrical Development Company; vice-president of the Toronto Railway Company; vice-president of the Sao Paulo Railway, Light & Power Company; vice-president and general manager of the Canadian General Electric Company; vice-president of the Canada Foundry Company; vice-president of the Dominion Iron & Steel Company; president of the Canadian Shipbuilding Company, etc., together with directorate interests in Cuba, Brazil and Argentina. He has not confined himself to electrical and engineering firms, however, being also director of the Canadian Northern Railway, Western Assurance Company and the Canadian Bank of Commerce.

Water Power on the Columbia River.

One-third of the water power of the United States is in Oregon and Washington.

Government engineers reported an average flow in the Pend Oreille River, at Priest River, Idaho, during the year 1904 of 28,130 second-feet. This is a very steady stream, the ratio of its maximum to its minimum flow in that year being 12 to 1. Compare that with a few eastern streams: the Hudson at Mechanicsville, N. Y., 80 to 1; the Susquehanna at Harrisburg, Pa., 49 to 1; the James at Buchanan, Pa., 76 to 1; Yadkin at Salisbury, N. C., 51 to 1; the Tennessee at Knoxville, Tenn., 57 to 1; the Merrimac at Garvin Falls, N. H., 30 to 1; the Potomac at Point of Rocks, Md., 168 to 1.

There are three lakes, Flathead, Pend Oreille and Priest, having a possible storage capacity sufficient to maintain a constant flow during the low-water months equal to half the average for the year. The drop of the stream between Lake Pend Oreille and the Columbia River is 750 feet, mostly within a small part of its course. It will be safe to assume an available fall of five-sixths of the whole fall, that is, 625 feet. The result of a useful effect of eighty per cent of the theoretical power would amount to 800,000 horsepower. By the terms of the treaty with Canada only 20,000 cubic feet of water per second can be taken from the Niagara River at the falls on the American side. The fall is about one-third as much as the estimated available fall of the Pend Oreille

Statistics on Wooden Poles.

A preliminary statement showing the number of poles purchased by the telephone and telegraph, steam and electric railroad, and electric light and power companies in the United States during the years 1910, 1909, 1908, and 1907, was recently issued by Census Director E. Dana Durand. The data were compiled in co-operation with the Forest Service of the Department of Agriculture, and form one of the series of annual reports containing statistics in regard to the lumber and timber industries.

Of the 3,870,694 poles purchased during 1910, 2,831,810, or 73.2 per cent, were reported by telephone and telegraph companies; 733,092, or 18.9 per cent, by electric railroad, light, and power companies, and 305,792, or 7.9 per cent, by steam railroad companies.

The total number of poles purchased in 1910 by all users of these materials, while greater than the number in 1909 by only 3.5 per cent, exceeded that of 1908 by 19.1 per cent, and of 1907 by 17.9 per cent. The steam railroads reported 110,471 more poles purchased in 1910 than in 1909, and the electric railroad, light, and power companies increased their purchases by 105,678. The number reported by the telephone and telegraph companies, however, was slightly less than in the preceding year, the decrease amounting to 84,195.

In 1910, as in each of the three preceding years, more poles were cut from cedar than from all other woods combined. The proportion contributed by this species, however, has been steadily growing smaller, the percentage of cedar poles in the total of 1910 being 62.8, as against 65.3 in 1909, 67.7 in 1908, and 64.2 in 1907. Undoubtedly cedar leads all other woods in the possession of those qualities most sought after in pole material, hence the increasing proportion of other woods reported during recent years is clearly a logical result of the growing scarcity of cedar timber, together with the consequent advance in its cost. While twenty-eight different woods were reported as drawn upon for pole material during 1910, four species—cedar, chestnut, oak, and pine, ranking in the order given—contributed more than ninety per cent of the total during each of the four years covered by the report.

Among the woods used in relatively smaller quantities as pole material, a marked decrease is noted in the case of cypress, the number reported from this species in 1910 being only about seventy-five per cent of that shown for 1907. Principal among the causes of this decrease is, of course, the high and increasing value of this wood as lumber and shingle material. On the other hand, the number of Douglas fir poles has increased rapidly during the four years, the total reported for 1910 being nearly four times as great as that for 1907, while a substantial gain was also made for each of the intervening years.

An interesting fact disclosed by the figures is the rapid growth of the practice of treating poles in order to prolong their period of use. In 1910 824,673 poles, or more than twenty-one per cent of the total reported purchases for that year, were given some preservative treatment. This number was an increase of 248,042 poles, or 43 per cent, over that of 1909; 480,285, or 139.5 per cent, over that of 1908, and 428,474, or 108.1 per cent, over that of 1907. In 1910 the class of pole users which applied preservatives most extensively was the electric railway, light, and power companies, 29.4 per cent of the reported purchases having been given some treatment of this character, as against 19.9 per cent by steam railroads and 19.4 per cent by telephone and telegraph companies.

A comparative statement is made in the form of the accompanying table:

KINDS OF WOOD.	NUMBER OF POLES PURCHASED. 1910	1909	1908	1907
Total	3,870,694	3,738,740	3,249,154	3,283,268
Cedar	2,431,567	2,439,525	2,200,139	2,109,477
Chestnut	677,517	608,666	516,049	630,282
Oak	265,290	236,842	160,702	76,450
Pine	184,677	179,586	116,749	155,960
Cypress	75,459	77,677	90,579	100,368
Douglas fir	56,732	24,877	19,542	15,919
Tamarack	30,964	29,889	24,123	13,884
Redwood	30,421	23,145	13,061	31,469
Osage Orange	23,221	21,491	18,109	5,962
Spruce	22,929	11,423	8,088	10,646
Juniper	20,042	43,581	42,367	38,925
Hemlock	12,773	6,222	1,998	3,301
Locust	9,030	10,463	10,224	4,672
All other	30,072	25,653	27,424	85,953

Ornamental Street Lighting in East Chicago.

Negotiations have been completed between merchants of the city of East Chicago, Ind., and the Northern Indiana Gas & Electric Company for the installation of an ornamental system of street lighting in the business district of that city.

The initial installation will comprise about 170 posts. The type of post has been decided upon and actual work will start in a short time.

Los Angeles Railway Employees' Outing.

Under the auspices of the Los Angeles Railway Recreation Association, Los Angeles, Cal., the second annual picnic of the employees of that company was held at Redondo Beach on September 16, with a total attendance closely approximating sixty-five hundred persons, inclusive of employees and their families.

Free P-A-Y-E cars were provided by the company to transport the gathering to and from the beach, being run over the narrow-gauge Los Angeles-Redondo route, of the Pacific Electric Railway Company. The general offices of the company, and the mechanical and electrical departments were closed throughout the day, the employees of such joining the platform men of the four divisions of the system in a period of recreation.

A program of athletic and aquatic sports, with prizes for successful contestants, was held under the management of W. Harry Stone, of the general amusement committee. The outing was one of the largest and most successful on record at the beach town.

Car-Lighting Club.

The regular monthly meetings of the Car Lighting Club were resumed on Wednesday, September 20, at the Kuntz-Remmler Restaurant, Chicago. The paper of the evening was entitled "Axle Pulleys and Chain Drives," by George R. Shirk, chief electrician of the Chicago Great Western Railroad.

Coal Production in Tennessee.

The total production of coal in Tennessee in 1910 was 7,121,380 short tons, valued at $7,925,350, an increase of 14 per cent over the production of 1909, when the output amounted to 6,358,645 short tons, valued at $6,920,564. The increased value of the output also amounts to about 14 per cent.

The Central Station in Buenos Ayres.

Installation of a 11,200 Horse-Power Turbo-Tandem Generator.

The central station of the Deutsch-Ueberseeischen Elektrizitätsgesellschaft in Buenos Ayres, Argentine Republic, will eventually have ten turbo-alternator units of the Parsons type of 11,200 horsepower each, of which five have already been ordered and one has already been installed. Four of these turbines will be direct-connected to three-phase generators, having a continuous output of 7,500 kilowatts, and a maximum capacity of 9,000 kilowatts. The fifth unit, shown in Fig. 1, will operate two generators of the same power. Three of these turbines were built in the works of Franco Tosi in Legnano, and two in the works of Brown, Boveri & Company, in Mannheim, Germany. All six of the three-phase alternators were built by Brown, Boveri & Company.

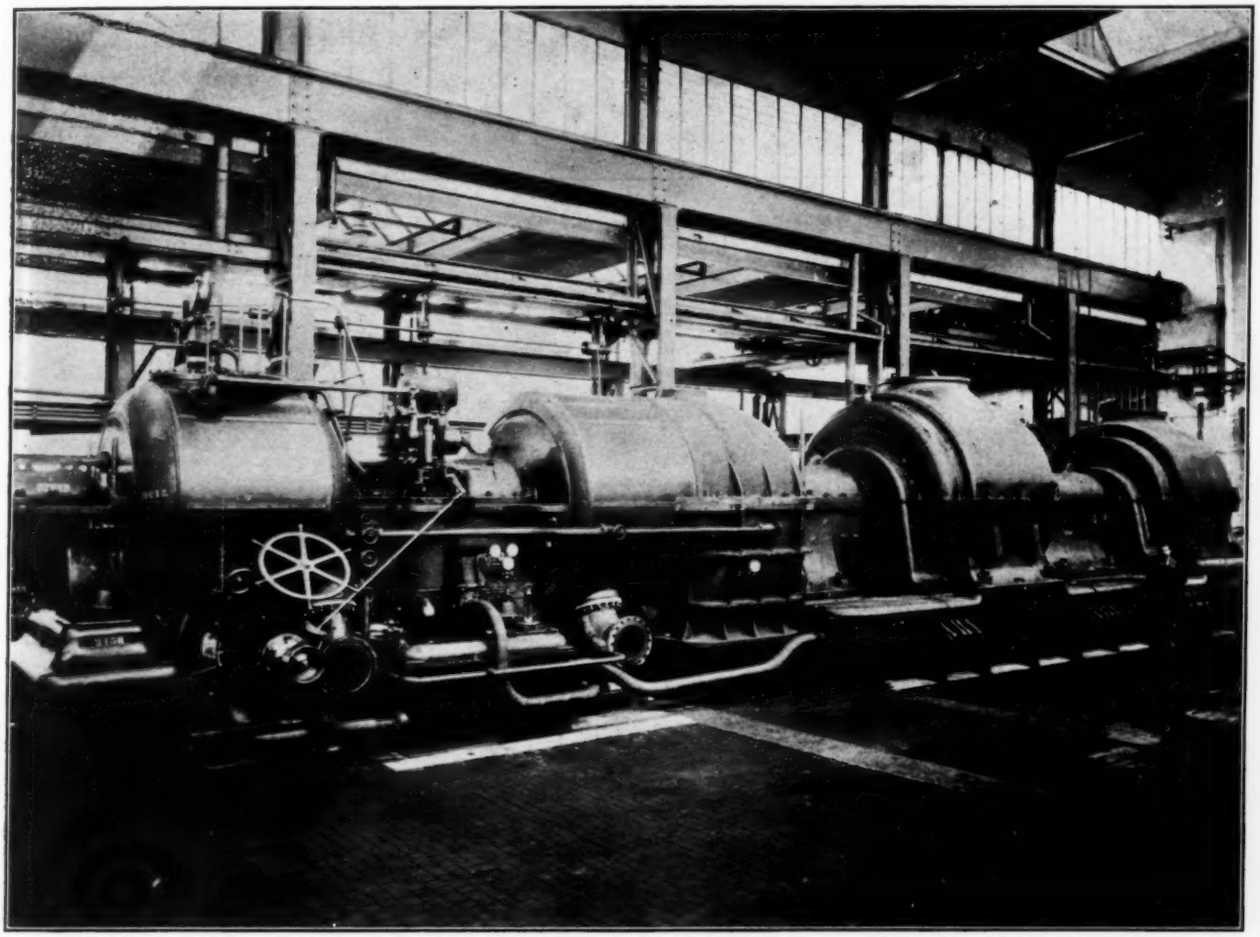


FIG. 1.—11,200-HORSEPOWER TURBO-TANDEM GENERATOR.

The turbine in Fig. 1 furnishes 11,200 horsepower at the normal speed of 750 revolutions per minute, and is operated in connection with a surface condenser. Steam is supplied under a pressure of 175 pounds per square inch, superheated to a temperature of 300 degrees centigrade. It can be overloaded up to 14,200 horsepower for a period of two hours. The normal consumption of steam is 6.3 kilograms per kilowatt-hour under a load of 7,500 kilowatts, and with cooling water at fifteen degrees centigrade. Of the two generators direct-connected to the steam turbine in Fig. 1, one operates at twenty-five cycles and 12,000 to 13,000 volts, and has a capacity of 8,350 kilowatts; the other at fifty cycles and 12,500 volts and has a capacity of 8,825 kilowatts. Exciting current for both generators is furnished by a direct-connected exciter of 110 kilowatts at 220 volts.

The surface condenser has a cooling surface of 1,300 square meters and with a sufficient quantity of cooling water at fifteen degrees centigrade can maintain a vacuum of 95 per cent. With cooling water at twenty-five degrees a vacuum of ninety-one per cent is obtained. The weight of the entire group including the condenser is 475 tons.

STEAM TURBINE.

The turbine is operated in two stages with intermediate steam chamber, and on account of the great size in order to secure the greatest economy in steam consumption. This arrangement permits the use of the Parsons method of construction with a large number of rows of blades, so that the highest possible efficiency can be obtained. In ad-

dition the high temperatures are confined to a relatively small, high-pressure cylinder so that distortion due to temperature variations is eliminated.

On the other side of the high-pressure cylinder the main steam pipe containing the main valve is brought. From here the steam passes through two tubes to the double-seated governor valve. The rod of this valve is operated by high-pressure oil in place of steam as formerly used in the Parsons turbine. This oil is taken from the general oil supply, which has the advantage that if at any time the lubrication is interrupted the turbine will be automatically stopped. The spring regulator which controls the relay on the governor valve is directly over the oil pump and is driven through gear wheels. The safety regulator is also mounted here and if the speed is raised fifteen per cent above the normal it is thrown out and causes the main valve to close. On the opposite side and

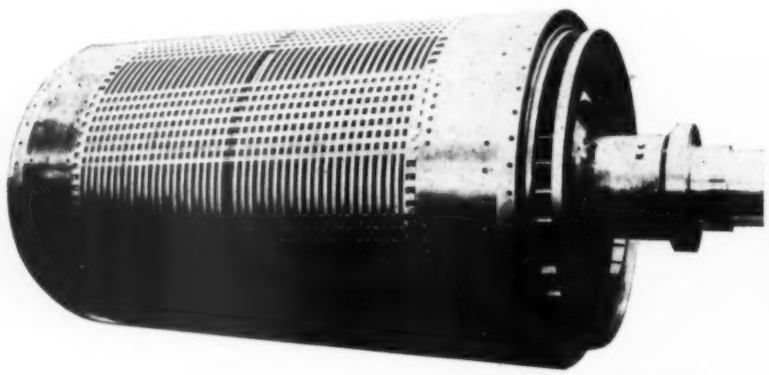


FIG. 2.—ROTOR OF 7,500-KILOWATT, 6,250-VOLT, 50-CYCLE GENERATOR.

symmetrical to this apparatus and driven by the same gear wheel is a second oil pump, which operates in parallel with the first to supply oil at a pressure of one and one-half atmospheres. The oil is drawn by the pumps from the receptacle in the bed plate of the turbine and is driven through a cooler to the various bearings from which it flows back to the receptacle.

The shaft of the turbine is made of forged steel. Its ends are provided with cast-steel bearings which are furnished with steam jackets on the side where steam is admitted, in order that they may rapidly reach a uniform temperature. The axial pressure is balanced by means of collar bearings. The one which balances the reaction of the low-pressure cylinder, which in the early Parsons turbine had very large dimensions, is built on the low-pressure end of the shaft after the patent of Fullager. Each shaft is held in the proper position by means of a bearing and the two are connected together by an elastic coupling.

ALTERNATORS.

The alternators have rotating fields and stationary armatures. In order to secure an efficient ventilation they are inclosed in a special housing. The sheet steel in the armature frame is laminated and consists of a large number of pockets which are so spaced from one another that the ventilating air has sufficient passage room and comes in contact with a sufficient cooling surface. The entire mass is secured at both ends by plates under pressure and by that means secured to the housing. The armature windings are fastened in the slots by means of wedges. The ends of the windings which are led out of the housing are held in insulating clamps which prevents any displacement through either mechanical or electrical force. All of the high-tension windings are inclosed and protected from any outside contact.

The sheet steel forming the cylindrical magnet cores is separated by spacing pieces which allow the passage of the cooling air and are provided with slots for holding the windings. The windings are formed out of copper ribbon and are so placed in the slots that the centrifugal force drives them against the broad surface of copper strips secured by metal wedges, which prevents any shifting of the conductors. The ends of the field windings are protected and held in place by massive protecting pieces of non-magnetic metal. All of the magnet windings are provided with good ventilation. The two alternators are mounted on two bed plates which are screwed up to one another.

The system of ventilation is one patented by Brown, Boveri & Company. Cold air is drawn in at both ends of the machine through openings in the bed plate and is driven by two ventilators fastened to the rotor through the windings and through small canals in the magnet cores, pole pieces, and armature core, and finally pass out through the openings which are provided in the armature housing. By this means a uniform warming of the different parts of the machine is attained and consequently a uniform expansion of all parts, so that unbalancing due to this or to the shifting of one winding over another is avoided.

The alternators can carry an overload of twenty-five per cent for one-half hour without damage. The temperature rise

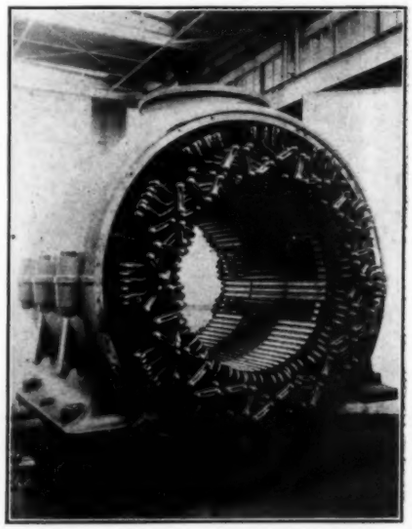


FIG. 3.—STATOR OF 6,250-VOLT GENERATOR.

for an uninterrupted run of ten hours in the warmest part of the iron or windings will not exceed forty-five to fifty degrees centigrade above that of the surrounding air.

The weight of a complete generator without the bed plate and mounting is 73.4 tons, the stator weighing 48.1 tons and the rotor 25.3 tons.

Cleveland Municipal Lighting Plant Affairs.

The city council of Cleveland has adopted the Pelcinski resolution submitting the question of issuing $2,000,000 worth of bonds for the purpose of constructing a new and larger municipal lighting plant to a referendum vote at the coming election. It has been proposed to erect a 14,000-kilowatt plant on land now belonging to the city and located near the down-town water front.

The Tesla Turbine.

The accompanying illustrations which were taken at the request of the editor of this journal, give a very good idea of one of the small Tesla turbines which have been built and operated with slight changes of the rotors and accessories as steam, gas, air and water turbines or rotary engines, and also as pumps and compressors. The characteristics and the mechanical principles involved in the construction and operation of the Tesla turbine were discussed comprehensively in the

THE TESLA 110-HORSEPOWER TURBINE, CONVEYING AN IDEA OF THE SIZE OF THIS MACHINE.

ELECTRICAL REVIEW AND WESTERN ELECTRICIAN of September 9. Through the courtesy of the New York Edison Company the machine illustrated was installed at its Waterside station where long-continued tests were carried on under greatly varying conditions.

Mr. Tesla, when seen on Tuesday of this week by a representative of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, gave the following statements respecting the operation and economy of his turbine:

"The turbine has readily developed 110 horsepower with free exhaust, but this does not convey even an approximate idea of the possibilities offered in power production by the new principle of propulsion. It would not have been difficult to develop twice as much power were it not for the torsional stress to which the shaft was subjected. However, even with the result attained, bearing in mind that the rotor weighs only twenty pounds, and that the casing itself could have been pressed steel sheet, the weight of which together with the bearings would not exceed thirty pounds, a performance of more than two horsepower per pound of material was realized.

"As to steam economy, it is highly satisfactory, comparing well with the best turbines, the consumption being thirty-six pounds per horsepower-hour with free exhaust and back pressure of a few pounds, which would mean less than seventeen pounds for a two-stage machine of that size. This economy could still be greatly increased for the turbine was operated under conditions of maximum output and not maximum economy."

Mr. Tesla stated that there was no limit to the capacity for which this turbine could be built and said that the peculiar characteristics of this form of construction would make it possible to attain economy of operation with superheated steam not heretofore realized. When operated as a water turbine it greatly simplified the present methods of regulation and opened up a field of application which was stupendous.

Courses in Lewis Institute.

The Lewis Institute of Chicago has just issued a schedule of continuation courses which will be given evenings and Saturdays, beginning October 9, 1911.

The schedule includes engineering, chemistry, physics, mathematics, drawin, languages and household arts. The courses are arranged so that they can be taken independently or in connection with regular college work or in series to form a logical development of the subject. In general, the courses are designed to afford those who are employed an opportunity to continue their vocational studies. Of the total enrollment of 3,200 during the past season, over 1,800 were enrolled in the continuation classes.

The engineering series includes engineering principles, electrical measurements, direct-current machinery, rotary-converters in substation work, alternating-current principles, transformers and transmission lines, alternating-current motors and generators, steam-engine testing, internal combustion engine, structural-steel design, and also work in connection with the characteristics and properties of reinforced concrete.

The mechanic-arts series includes mechanical and architectural drawing, machinery drawing, machine design, lathe and milling-machine work, tool and die making, pattern making, foundry and forge work.

The mathematics series is especially arranged for engineers and includes algebra, geometry, trigonometry, analytics and calculus.

Work is also offered in English, Latin, German, French and Italian.

THE ROTOR OF THE 110-HORSEPOWER TESLA TURBINE. WEIGHT, TWENTY POUNDS.

The tuition is $5.00 per term of ten weeks, with $5.00 extra where laboratory or shop work is included.

Full information may be obtained by addressing Director Carman at Lewis Institute, Madison and Robey Streets, Chicago, Ill.

Chicago & Milwaukee to Reorganize.

Final details of the plan for reorganizing the Chicago & Milwaukee Electric Railroad have been made public. It is stated that a new Illinois corporation will acquire the properties of both the old Illinois and Wisconsin railroad companies.

The new corporation will issue $4,000,000 first-mortgage five-per-cent bonds, $4,000,000 four-per-cent first income bonds, $5,000,000 four-per-cent second income bonds and $6,000,000 of stock, all of one class.

Illuminating Engineering Society.

Fifth Annual Convention, Chicago, Ill., September 25 to 28.

The fifth annual convention of the Illuminating Engineering Society was opened on Monday, September 25, in the Congress Hotel, Chicago. This is the first time that the Society has ventured so far from the Atlantic seaboard and the success of the convention is very gratifying to those who have the interest of the Society at heart. The registration on the first day amounted to over 100 and this was afterwards increased by the late arrivals.

As President A. E. Kenneley was detained in Europe by the International Congress at Turin and was unable to be present, the first session was called to order by Vice-President V. R. Lansingh at 11:10 a. m. on Monday morning. John F. Gilchrist, chairman of the General Convention Committee, made a brief address of welcome, and Joseph D. Israel, chairman of the Philadelphia Section, made an appropriate response. The chairman read the address of the absent president, which was entitled "The Relations of Physico-Physiological Research to Illuminating Engineering."

PRESIDENT'S ADDRESS.

I desire to submit for consideration the importance of activity and research in the measurement of light.

Every department of natural science takes its origin in a collection of scattered collated observations. At first, these may seem disconnected, and at variance. In the earlier stages of any science, there is a constant increase in the number and complexity of the observations, with little or no gain in their perspective, or in the apprehension of their mutual relations. After the science has reached a certain stage of development, depending upon its extensiveness, the relations of the various observations to each other become apparent. The observations still increase in number and complexity; but they arrange themselves into co-ordinate groups. It is found that the various phenomena are related in a definite and apparently unvarying manner. This is the stage of discovery of law. A great change appears in the psychological aspect of the science. The highest development of a science known to us is that in which all the laws are recognized and are exceedingly simple, so that they may be reduced to the operations of simple arithmetic. Every observation becomes associated with its proper phenomenon. Every phenomenon becomes connected with its proper law. Every law becomes amenable to simple arithmetic. When we acknowledge that a science is very difficult to understand, we admit that it is undeveloped. All the natural sciences aim at becoming exact sciences, and become exact through the making, correlation and reduction of measurements. Any branch of natural science without measurements is not above the qualitative stage. The measurements connected with the quantitative sciences, on which illuminating engineering depends, are mainly photometric measurements. Not only is the precision with which a judgment of equal illumination can be made relatively small, but the precision with which our standard illumination can be independently re-duplicated is also relatively small. Our flame standards are so inferior, in this respect, that they have been abandoned in the maintenance of the international candle, in favor of a group of incandescent lamps. It is also known that the sensation of light, or the candle-lumens per unit of radiant power-density is very different for different frequencies. The eye is more sensitive in the yellow-green than at either end of the spectrum. The lumens per area-watt are known to be greatest at or near the frequency which is most prominent in daylight. But when the radiant power-density is feeble, and the candle-power perceived is low, the lumens per area-watt are known to be greatest at a somewhat different frequency; so that the relative sensibility of the eye to stimulus, at different frequencies, varies with the intensity of the stimulus. Much remains to be investigated before our knowledge can be regarded as satisfactory along any of these lines. Assuming that we possessed a proper knowledge of the lumens per area-watt, for all the different colors and frequencies of light, at all working intensities, it would become possible to make a spectro-photometrical examination of the light from any lamp, then average the lumens per area-watt over the whole of its spectrum, to measure the total radiant power of the burner in watts, and then express the radiation-density in watts per lumen in a significant manner. All research connected with photometry borders on the work of ocular physiology, and of psychology. Consequently, all such research, in order to be most effective, should be undertaken with adequate information concerning what has already been accomplished in those sciences along similar lines. Since it has probably taken millions of years to develop the human eye it is not wonderful that the study of the eye should be so difficult. It might be supposed that the knowledge, in a few laboratories, of certain physical-physiological constants for the human eye was of no importance to the broad industry of illumination, to its manufacture, engineering, distribution, or sale. On the contrary, all such knowledge is of great importance to the industry in many ways. All such knowledge rapidly begets applications, improvements, economies, in a manner of which modern experience affords many examples.

Motions were made by E. P. Hyde and carried, expressing regret at the President's absence and referring his address to a committee. The chairman appointed on this committee J. R. Cravath, H. E. Ives and W. H. Gartley.

A report of the Committee on Nomenclature and Standards was read by the secretary. This consisted of a report prepared by the Sub-Committee on Photometric Units.

REPORT ON NOMENCLATURE.

The committee has been in communication since the last convention with C. C. Patterson of the English National Physical Laboratory, A. G. Trotter of the Board of Trade, Eric Gerard of the Montefiore Institute in Belgium, and Ormond Higman of the Canadian Government Laboratory at Ottawa. Little progress can be reported but the committee recommends that the term "lighting" be used to designate the product of luminous flux and time, the symbol being L instead of O as reported last year. The committee also recommends symbols proposed by Blondel to immediately follow the letter I for candlepower and F for flux. The symbol consists of a horizontal bar intersecting a circle, when mean spherical candlepower or total flux is intended; the same bar with the upper half of the circle to represent upper hemispherical candlepower or flux; and the bar with the lower half of the circle to represent lower hemispherical candlepower or flux.

A written discussion of this report was sent in by A. S. McAllister, in which he objected to the adoption of symbols which could not be readily printed, as the result could not be a very general use of them. He objected to the duplication of certain symbols in the Standardization Rules in the American Institute of Electrical Engineers, the letters I, E. and R being used for both electrical and photometric quantities, and these sometimes occurred in the same equations. He suggested the use of the Greek letter psi (Ψ) for light flux, and the Greek letter beta (β) for light flux-density. These would correspond to the letters Φ and B for magnetic flux and magnetic flux-density.

A report of the committee on progress was then presented by Percy W. Cobb.

REPORT ON PROGRESS.

No radical innovations in either material or methods have occurred during the past year. In arc-lamp practice the tendency is toward the use of luminous and flaming-arc types. The electrodes for the magnetite arc are produced of more uniform and better quality. These arcs are replacing alternating-current and inclosed arcs with general improvements in both illumination and cost. The titanium-carbide arc has, owing to difficulties in construction and operation, not come into use. The flame-arc has been handicapped by expensive electrodes and the necessity for frequent trimming, but the advent of long-burning electrodes, attained by increasing the diameter, increasing the length and changing the composition, has decreased this difficulty. There are several lamps now on the market capable of burning about seventy-five hours per trim at an efficiency slightly less than that reached by intensive burning. It is not expected that the life can be increased beyond this value without objectionable loss of efficiency. The strongest point of these new lamps is that they may be successfully used with alternating current and constitute a more useful and efficient lamp than any of the alternating-current arcs heretofore employed. Small intensive arc lamps with carbons of one-quarter inch diameter and requiring about five or six amperes are being used more extensively since they have been pushed with slight loss of efficiency to a burning life of forty or fifty hours. Quartz mercury-arc lamps have been introduced in this country

and have had an effective life of several thousand hours with a great improvement in color over the ordinary mercury lamp. A novelty which has been introduced abroad is the Moore tube filled with neon. The consumption is under one watt per candle and the light of a warm and mellow color. The most important advance in incandescent lamps is the commercial introduction of drawn-wire tungsten filaments. The tendency in size is upward, 400 and 500 watts being customary. The tantalum lamp is still produced in large numbers, but is not likely to withstand the competition of the new tungsten lamps. Incandescent mantles for gas lamps have undergone considerable improvement, the life being longer and the maintenance of candlepower better. Ramie fiber is coming into use as a mantle material, but artificial silk or cellulose is superior to it. Another improvement in mantles is the introduction of more ceria, which reduces the efficiency slightly, but gives a better color. High-pressure gas lighting has been tried in a few places, but the special distribution system which is necessary seems to stand in the way of commercial progress. Gas fixtures have been materially improved and shock-absorbing devices have reduced the breakage of mantles. The inverted Welsbach is displacing the older upright form. The pressure-wave system for street-lamp lighting is widely used abroad and should find larger employment. In the practice of illumination there is a gradual evolution toward a higher degree of lighting and better designed shades and reflectors with a tendency upward in the amount of illumination. The lavish and reckless use of unscreened arc lamps in display lighting is on the increase. In indoor lighting the tendency is toward the use of indirect and especially semi-indirect illumination. A large variety of new glassware for both gas and electric lamps has been put on the market. Reflectors have undergone steady improvement and both glass and metal have been worked out in a variety of designs. Sockets and shade holders permitting the adjustment of the lamp in the shade are now available. The American Association for the Conservation of Vision has been formed during the year and will will reinforce the efforts of this Society toward the improvement of illumination.

In discussing this report George S. Barrows spoke of the use of high-pressure gas in Europe. The first installation there had individual pressure plants and special mains were only introduced when the number of consumers warranted it. It is unnecessary to have special mains in order to use a pressure wave in lighting street lamps. There are probably 250,000 lighted in Europe in this manner without special mains, and he spoke of two instances where the method was used in this country.

John G. Henninger, Jr., spoke of the recent development of metallic reflectors, of which there were many more types available than formerly. These give a very good efficiency, as much as sixty-five per cent of the light being available in the lower hemisphere and fifty to seventy per cent in a zone sixty degrees around the vertical.

E. L. Elliott called attention to the use of a magnetite arc without a globe, which he condemned, as this is the most intense source of light known. The only excuse for it is economy. Opalescent globes absorb blue rays more than others, and this arc is strong in the blue end of the spectrum. This may have militated against the use of globes.

L. D. Marks spoke of the extended use in factory lighting of systems of general illumination supplemented by local illumination. The former practice of using exclusively local illumination is being greatly improved. He commented upon the absence of any reference to daylight illumination in the report.

J. R. Cravath supplemented the previous speaker's remarks and questioned the existence of any metallic surface which could give such a high reflection as that indicated by Mr. Henninger.

F. E. Cady, W. M. Skiff and S. L. E. Rose also took part in the discussion, the latter pointing out that the use of appropriate inclosures for flaming-arc lamps had increased the life of the electrodes to 80 and 100 hours and that the deposit from the fumes had been greatly remedied.

AFTERNOON SESSION.

The entire session on Monday afternoon was devoted to the reading of papers on illuminating glassware. The first was a symposium on the subject by representatives of three different manufacturers, preceded by a brief introduction from Bassett Jones, Jr., chairman of the Committee on Papers, and read by W. E. Barrows, Jr. The contribution of George H. McCormack was read by F. L. Godinez. A. J. Marshall then presented a summary of the Holophane system of prismatic globes and reflectors. S. G. Hibben read the concluding section by L. W. Young, dealing with the characteristics of Alba glass. A paper by E. H. Bostock on "The Manufacture of Glass for Illuminating Purposes" was read by Secretary P. S. Millar. The final paper of the session was that presented by F. L. Godinez on "Requirements of Modern Reflector Design." Abstracts of these papers follow.

SYMPOSIUM ON ILLUMINATING GLASSWARE.

Part I, by Mr. McCormack, calls attention to the need for considerable variety in the design of illuminating glassware. There has been too much use of stereotyped forms when distinctive designs are needed. Merchants, particularly, need means for differentiating their stores from those of their neighbors even in the equipment of their lighting fixtures. The greatest problem before the manufacturer is to prevent monotony in lighting installations by designing efficient units that offer a wide and pleasing choice to the consumer. Overcoming of glare is another problem. Reflectors of clear, polished glass produce a decidedly objectionable glare as contrasted with opal reflectors having special depolished inner surfaces. This was graphically shown by illustrations. Differences of efficiency between any two different kinds of properly designed reflectors of the same general type are insignificant. The sparkle, color and life of opal glass is due to the perfect diffusion from the minute particles of opal suspended within the glass. Such glass permits of being molded into artistic shapes on the exterior of the reflector with a depolished inner surface.

In Part II, Mr. Marshall explained and illustrated the Holophane system of illuminating glassware, which comprises scientifically designed prismatic globes and reflectors for a great variety of requirements. These include four general classes: Class 1.—Prismatic, semi- or totally-enclosing envelopes in various forms, having both internal and external prisms; these prisms both redirect and diffuse the light flux which strikes the inner surfaces of such envelopes. Class 2.—Prismatic reflectors in numerous shapes, designs and treatments, giving any desired distribution of light; most of these reflectors have vertical external prisms and clear inner surfaces. Class 3.—The combination of Classes 1 and 2. Class 4.—The combination of Classes 1 and 2 with clear, ground, acid-treated, milk, tinted and other glasses not having as part of themselves prisms; this glass is used primarily for diffusing and artistic effects. Aside from the principal classes just mentioned, there are a number of units made possible through a combination of these classes. He described the development of the system and showed the unreliability of non-calculated imitation prismatic globes. The effect of dust on a scientifically designed prismatic globe is very small. Any desired distribution of the light may be obtained. Single lamps are preferable to a cluster within a prismatic hemisphere. The open reflectors are made in three general types, extensive, intensive and focusing. Reflectors may easily be made decorative, as well as utilitarian, and they may be combined in various special fixtures. It is important that the proper holder be used, because a wrong relative position of lamp and reflector defeats the result desired. By combining prismatic with other glassware, a great variety of pleasing and useful effects are obtained. Mr. Marshall closed his section by a brief description of the manufacture of Holophane prismatic glassware.

Part III, by L. W. Young, dealt with Alba glassware, which is made up in three general forms: (1) commercial shades, (2) balls, globes and stalactites, (3) bowls, urns and similar decorative pieces and special shapes. Alba glass is of a clear or crystal base, holding in itself by a species of colloidal suspension a great number of infinitesimal flakes, which give color to the glass, break up the rays of light and aid in their reflection. It is entirely distinctive from milk or opal glasses. Among its advantages are claimed to be good reflection, efficient and diffuse transmission, adaptability to artistic treatment in both varied designs and colors. Alba globes have a total absorption of 13.5 per cent. Being perfectly smooth this glass is very easy to clean thoroughly. It is not easily broken by clamping under set screws. Among special forms of Alba glassware are pendent spheres, dish-shaped shades for indirect lighting, urns and artistic shades for decorative lighting. The great variety of forms and colors available provides a wide latitude of choice to the illuminating engineer in meeting any requirements.

MANUFACTURE OF GLASS FOR ILLUMINATING PURPOSES.

Mr. Bostock's paper removes much of the mystery that has surrounded the art of glass making. He defines glass in very broad terms. Its chief ingredient is common sand, to which are added and fused a great variety of chemicals, depending on the physical qualities that the product is expected to have. Mr. Bostock mentions a large number of chemicals and the influence they have on the hardness, elasticity, cold and other properties of glass. He describes the manufacture of glass and particularly the four methods of forming glass ware for lighting purposes. The most brilliant surface is produced by an "off-hand" method of blowing, the paste-mold, two-piece mold and press methods following in order. The author takes up at some length the attainment of various colors and of various degrees of etching. He urges against the use of sand-glass for lighting ware. Phosphate glass is probably the most perfect diffuser. Opalescent glass is too absorbent for much use in lighting outside of that for decorative effect. Daylight prismatic glass forms the concluding topic of the paper.

REQUIREMENTS OF MODERN REFLECTOR DESIGN.

Mr. Godinez in the opening of his paper makes a plea against too much repetition of standard designs in laying out lighting installations which produces decided monotony. Manufacturers of reflectors have not made a sufficient effort to provide for a sufficient variety of reflector designs to meet the various demands for contrast, effect and appearance. The author then gives the results of some ultra-microscopical investigations of the minute particles within the construction of glass. After describing the instrument used he gives a number of illustrations of ultra-microphotographs of various kinds of glass and explains the theory of dispersion and transmission for these different glasses. He lays great stress on the need for preventing the very decided glare resulting from illuminants of high intrinsic brilliancy. Use of opal glass in the molded form with appropriate ornament is peculiarly adapted to the environment of the home. It is there particularly where glassware typical of commercial installations should be barred. Great attention is necessary to the matter of color in order to bring out the proper element of repose which is the basis of home life. The author has developed a new type of glass that is manufactured in a delicate amber tint and also in a very subtle tone of old rose. An irridescent effect is readily attained by special treatment of its surface. He shows several designs of fixtures in which some of this glass has been used. Taking up the open shades or reflectors, he discusses the marked prevalence of specular reflection in many types of reflectors which result in very unsatisfactory illumination. On looking into a clear polished prismatic reflector a very decided glare effect is produced. To eliminate this, depolishing of the inner surface is essential. In conclusion Mr. Godinez makes a strong plea for the drawing up of standardization requirements by the Illuminating Engineering Society.

TUESDAY SESSION.

The Tuesday session was called to order at 10 o'clock, with Vice-President H. E. Ives in the chair. The session as opened by a general discussion of the papers on illuminating glassware that had been read on Monday afternoon.

V. R. Lansingh, of New York, opened this discussion by stating that all prismatic reflectors are made by the molding process, thus producing slight striations on the surface, due to the cooling of the glass in the mold. These, however, are removed by subsequent heating in a gas-fired furnace, so that the surface is perfectly smooth. He did not believe that Mr. Bostock is quite right in ascribing such high reflective power to the opal particles that are found in opal glass. In order to get appropriate results from this kind of glass a considerable thickness is necessary, which means a rather high absorption of light. He did not agree with Mr. McCormack in stating that specular reflection is synonymous with glare. On the contrary, he contended that it makes no difference as to the character of the light-source, whether it reflects by specular or diffuse reflection, so long as the illumination on the working plane is the same. Referring to Mr. Marshall's paper, he emphasized the value of a prismatic reflector placed inside of glass spheres. He also called particular attention to the great flexibility of the Holophane system of prismatic reflectors in permitting any desired results to be attained. However, prismatic reflectors must be used as they were designed to be used, otherwise the results cannot be guaranteed. Mr. Lansingh also commented on the increased absorption of molded Alba glass as compared with that which is blown. In conclusion, he objected to the statement by Mr. Godinez that the regular commercial types of glassware should not be used in residence illumination. This is quite true in residences of the highest type, but in nine out of ten residences the funds available for lighting equipment do not permit of very distinctive and artistic lighting. In all this vast class, commercial types of glassware, more or less modified to suit the conditions, are quite effectively and generally used.

Mr. Cady, of Newark, O., stated that some of the curves given in Mr. Godinez' paper showing the distribution curves of clear and satin-finished reflectors indicate that either the wrong type of lamp or an improper holder was used, because they are at variance with what has been found by the manufacturers in many tests, namely, that the satin finish produces a small percentage loss of efficiency. He also objected to the statement that prismatic reflectors have the same intrinsic brilliancy as bare lamps.

J. R. Cravath, of Chicago, said that there was an urgent need for the production of a smooth glass in flat plates that shall have about equal qualities to ground glass and be particularly appropriate for use in skylights. Manufacturers should endeavor to produce such a glass which would be easy to clean and yet have excellent diffusive powers. Ground glass, when once thoroughly soiled, can never be thoroughly cleaned.

Percy W. Cobb, of Cleveland, agreed with Mr. Lansingh that when an equal illumination is produced upon the working plane, it makes no difference whether that illumination comes from a source making use of specular reflection or one in which diffusive reflection is employed. However, he felt that it is highly desirable to have the source as free from glare as possible, because the eye is bound to observe the light-source more or less, even though it be placed out of the range of ordinary vision. Dr. Cobb felt that it was quite gratifying that manufacturers of reflectors are now producing depolished glassware so generally. Respecting the color effects alluded to in Mr. Godinez' paper, he thought that the tungsten lamp produces as mellow a light as that of the old kerosene lamp. In his own home he has a portable table lamp equipped with a tungsten filament and he finds it to give a rich, soft light. At his desk he has had available a tungsten lamp which was arranged to give a true artificial daylight effect, and he has noticed that practically everyone that has observed this lamp alongside of a carbon-filament lamp has been struck with its soft and mellow qualities as compared with the older lamp.

Norman Macbeth said he was glad to see such an array of papers on glassware, and also that the commercial interests were allowed to present the advantages of their products without fear that the editorial committee would eliminate all commercialism from the final report of the convention. Commenting on Mr. Marshall's curves that show the effect of dust on prismatic reflectors, these are apt to give a wrong impression of the true state of affairs, because they evidently are true only for closed globes. Ordinary open reflectors, which probably constitute the bulk of the prismatic re-

flectors in use, would doubtless show a decrease in efficiency of forty to fifty per cent from an equal amount of dust.

G. H. Stickney, of Harrison, N. J., stated that the surface illuminated, particularly in desk lighting, often reflects the source of illumination. Therefore, he felt that it was highly important that the source be as free from glare as it could be, that is, that depolpolished glassware should always be used. He also briefly commented on the high value of the papers presented.

A. J. Marshall, of New York, after a colloquy with Mr. Hibben in regard to certain statements found in Mr. Young's paper, contended that the large specks frequently found in Alba glass are really defects or bubbles which decidedly mar its reflecting power. He ridiculed Mr. Young's enumeration of numerous but highly conflicting advantages of this type of glass. A glass cannot be at the same time a perfect reflector and a perfect diffuser. Referring to the large installation of Alba bulbs in the new Chicago & Northwestern terminal station, he said that the filament can be easily discerned through the globe, which is objectionable. Replying to certain objections that had been raised in regard to the cleaning of prismatic glass, he stated that all illuminating glass requires cleaning, and, in fact, a colorless glass shows less dirt than a white or milky glass.

F. L. Godinez, of Jersey City, took issue with some of the remarks of Messrs Hibben and Marshall. Then he closed the discussion in reference to his own paper and that of Mr. McCormack by emphasizing the value of originality in store lighting as being a highly needed requirement in order to secure appropriate advertising. He concurred in the comments of several of the speakers that reflection from glazed paper or the glass tops of showcases is very marked, and this can be made unobjectionable only by using a non-glaring source; moreover, the eye is bound to wander to the light-source frequently. Distinctive and artistic lighting equipments for residences are imperatively needed. A soft, mellow light should be provided. In conclusion, he called attention to the fact that within sixty days the lighting companies in fifty-seven cities will announce to their patrons that they will place at their disposal their illuminating-engineering departments and that all installations designed by these illuminating engineers will be guaranteed to give satisfaction.

Mr. Marshall briefly closed the discussion of his paper by again emphasizing many of the points that have been brought out therein and meeting some of the objections that had been offered by some of the speakers. Mr. Hibben also closed the discussion on behalf of Mr. Young. After answering a number of questions that had been asked, he stated that the large specks found occasionally in Alba glass are not the normal ones that produce the diffusive and effective qualities in the glass. Fluorescence has been found in several tests as being somewhat characteristic of this type of glass.

NATURAL GAS.

George S. Barrows, of Philadelphia, then presented in brief abstract form his paper on "Natural Gas; Its Production and Utilization." He shows a large number of lantern slides of typical gas wells, the manner of piping the gas, and the manner of utilizing it in furnaces and for other miscellaneous heating purposes. The development of natural-gas wells has increased steadily. In 1909 there were 24,000 of them in operation. The consumption of natural gas likewise has increased at an extremely rapid rate, both in domestic and industrial service. The average price throughout the country for natural gas for domestic use is about twenty-four cents per thousand cubic feet and for industrial use about eight cents per thousand cubic feet.

F. H. Gilpin, of Philadelphia, then abstracted his paper on

RECENT SMALL GAS-LIGHTING UNITS.

Mr. Gilpin's paper considers gas mantle burners smaller than the ordinary size so designed as to give about twenty-five mean spherical candlepower. A number of these have been developed in Germany and England and a few in this country. Tests were made of their characteristics such as mean spherical candlepower, efficiency, etc. These tests are recorded at length in the paper. The general impression that the paper gives is that the small gas units have from twenty-five to thirty per cent higher efficiency than the similar units of ordinary size. In all types of small units all danger due to the breakage of glassware is greatly diminished.

This paper was discussed by T. J. Little, Jr., who did not agree with the conclusion that small gas units in general can be regarded as more efficient than the large ones. He had also noticed that the open-mesh mantles were more efficient than those of close mesh, which doubtless was because more light from the interior of the mantle is thereby emitted. Mr. Gilpin briefly closed the discussion of his paper.

The final paper of this session was one on "Recent Developments in the Manufacture of Incandescent Electric Lamps," which was presented in brief abstract form by J. E. Randall, of Cleveland, Ohio.

DEVELOPMENTS IN INCANDESCENT LAMPS.

Mr. Randall's paper is a general review of the development that has taken place in incandescent-lamp manufacture during the last ten years or so. In the years 1904-1907, inclusive, there was a sag in the general quality of carbon lamps accounted for principally by the larger proportion of low-wattage lamps and those above 100 watts which were produced during those years. Both the very small and the very large carbon lamps are known to be inferior to those between 50 and 100 watts. The metallized lamps have made steady improvement since 1907. Recent experiments show that metallized lamps as low as 30 watts can be successfully made. Taking up the metal lamps, the first of these was the osmium lamp, which received fairly successful commercial development in Europe. Its great fragility as well as the limited supply of osmium and the subsequent advent of the tungsten filament prevented further development of this type of lamp. The next metal lamp to be taken up on a large scale was the tantalum, which was handicapped neither by fragility nor meagerness of the supply. Its inferior performance on alternating current was known at the time it was introduced and this has prevented its general use in this country. It was the first real drawn-wire lamp. The tungsten lamp received its great development shortly after the osmium and tantalum lamps had been put into service. Without reviewing the well-known features of the tungsten development, Mr. Randall called attention to the recent production of drawn-wire tungsten filaments which now are produced on a very extensive scale. The tungsten wire may be considered to consist of pure metallic tungsten. Its structure is fibrous. During the burning life of the lamp it gradually changes to a crystalline form. However, the wire is less brittle at every stage in the life of the lamp than are pressed filaments. During the manufacture the lamps are handled with no particular extra care beyond that given to ordinary carbon lamps. This shows their hardiness before being placed in service. They require more careful handling as their burning life develops. After briefly referring to the methods of making the contacts in pressed filaments, Mr. Randall concludes with a comparison of the various types of filament lamps on the basis of filament performance. He also anticipates a further development in the carbon lamp which may again place it in the race for certain classes of service.

The discussion was opened by George H. Jones, of Chicago, who said that a few years ago many central-station companies had been quite a little concerned in regard to the effect that the higher-efficiency lamps would produce. However, the leading lighting companies, such as the one in Chicago, had had implicit confidence that these lamps would produce increased revenues, and the Commonwealth Edison Company has always accorded a welcome to the newer and more efficient

lamps as they were developed. He cited some interesting figures to show how the average monthly consumption in kilowatt-hours has increased despite the more general use of tungsten lamps. These figures are for the same autumn month in the last three years, and are as follows:

Year	Flat Buildings	Houses	Small Stores
1908	16	30	46
1909	17	32	48
1910	18.5	33	79

J. W. Howell, of Newark, N. J., called attention to the possibility that some of Mr. Randall's tables might be misinterpreted unless they were used with appropriate explanation. He stated that all the tungsten lamps made by the General Electric Company are now of the drawn-wire type. These lamps have a stiffer filament when burned at the same efficiency than the pressed filaments had. Moreover, they have only two contacts, as against the very many that were used in the older type of tungsten lamp; since all contacts carry away heat, especially in the large lamps, it follows that the latter have been improved very decidedly by using the drawn-wire process. The metallized-filament lamps have been improved a great deal in the last few years by eliminating all the defectives. He thought that they should receive more general use as compared with carbon lamps, for they cost only ten per cent more and are three times as good. He felt that it was poor practice now to use either large carbon or metallized-filament lamps, because the large tungstens have been so very radically improved.

Glenn C. Webster, of Cleveland, spoke briefly against making cheapness the first consideration in the selection of a lamp. The ruinous competition of a few years ago resulted in a marked slump in the lamp industry at the time. If the manufacturers were accorded a reasonable profit they would continue to improve their lamps.

W. F. Little, of New York, showed an apparatus that had been designed by the Electrical Testing Laboratories to test the relative ruggedness of incandescent lamps. This is done by mounting them on an arm which is raised and dropped by slowly progressive increments, a gauge indicating the drop at the point when the lamp filament breaks. He made some of these tests before the meeting. A carbon lamp remained unbroken after being subjected to even a four-inch drop, the maximum the machine was capable of. An old type of tungsten lamp with pressed filament broke when the drop became 0.15 inch. A new type of drawn-wire tungsten lamp did not break even at the four-inch drop. Taking a small tungsten lamp of the old type, he showed that it could withstand a drop of 0.06 inch, whereas a similar lamp with the wire-type filament broke at a drop of 3.75 inches.

Norman Macbeth said that the feature that had made the drawn-wire tungsten lamp particularly rugged was the fact that it had a continuous filament which eliminated the many fused joints. The small size of lamps (such as the twenty-five-watt) had been decidedly improved by using the drawn-wire filament. These have now been used in several street-car and subway installations with excellent results.

F. A. Vaughn, of Milwaukee, felt that there was need for small sizes of tungsten lamps, particularly for residence lighting. If the drawn-wire process could be utilized for such lamps it would open a considerable field in this line. It was to be hoped, therefore, that the manufacturers could provide small lamps of this type and yet instill confidence in their reliability.

Preston S. Millar declared that carbon lamps had been improved fifteen to twenty per cent within the last fifteen years and in the last few years also the metallized lamps have become entirely reliable. He felt that the profession and the entire lamp industry, in fact, should recognize the progressiveness of those central stations, like the one in Chicago, that have courageously taken the lead in actively pushing the tungsten lamp.

F. H. Aldrich, of Chicago, said that the International Harvester Company, with which he is connected, is now using in its various shops between 12,000 and 13,000 tungsten lamps with the most excellent results. They have replaced almost all other illuminants and are used in practically all the departments, even where triphammers are in service on the floor above. He has found that for 100 or 150-watt lamps the average life is 1,500 or more hours.

Mr. Randall closed the discussion by stating that his tables were drawn up to give only a general idea of how the lamp industry has developed. The table on the improvement of the filament was designed only to show that feature, eliminating all other variables. Those who for many years spent their energy in the development of the carbon lamp had done noble work and with very little reward. Their efforts aided very materially in the development of the new high-efficiency lamps. Regarding the development of drawn-wire tungsten lamps of small wattage at standard voltage, he felt that it was entirely feasible, because it necessitated merely the production of a smaller die for drawing the tungsten wire. However, he did know that such drawn-wire lamps would not be as hardy as the larger lamps, and, therefore, felt that this would limit their sphere of possible usefulness.

SECTION MEETING.

A meeting of section officers and those interested in the development of sections of the Society took place in one of the club rooms of the Congress Hotel on Tuesday evening, and was presided over by General Secretary Preston S. Millar, who is chairman of the Committee on Section Development. A very general and prolonged discussion took place of the general affairs of the Society, how its interests might be furthered, and its influence extended, this being broken up at a late hour with the most optimistic feeling of the future of the organization.

WEDNESDAY MORNING SESSION.

The session on Wednesday morning was called to order by Chairman V. R. Lansingh, and the paper by Ward Harrison and G. H. Magdsick, entitled, "The Analysis of Performance and Cost Data of Illuminants," presented by the former.

PERFORMANCE AND COST DATA.

This paper urges that performance and cost data should be brought together, tabulated in systematic form, and presented to illuminating engineers, through the *Transactions* for use in meeting illuminating-engineering problems. It is suggested that the manufacturers of the various commercial illuminants be invited to prepare papers on their respective products, contributing complete performance and cost data. This material would doubtless be augmented by the experience of illuminating engineers and consumers, and a fund of information would be provided upon which a man engaged in the practice of illuminating engineering might draw with a feeling of security; data which would bear the stamp of impartiality and reliability as engineering information rather than advertising material. The factors which determine the relative value of illuminants and which should be included in a comparative tabulation of data are grouped under two heads; first, illuminating power, and second, cost. In determining illuminating power it is important to consider the total flux from the unit, both the initial and the average, during the life of the renewal parts in the laboratory and under service conditions; the utilization of

this flux as determined by the size of the unit, the distribution secured and general adaptability to the given conditions; also the quality of the light, its steadiness and diffusion. The mean spherical candlepower or total light flux is, of course, the fundamental basis of comparison, and this should be obtained for each lamp with the various types of standard equipment. The discrepancies which are so common in cost data may be largely eliminated by a careful analysis. In determining the total operating cost of any system of lighting, three items should be considered: (a) Fixed charges, which include interest on the investment, insurance and taxes, depreciation of permanent parts, regular attendance, and other expenses which are independent of the number of hours of use. (b) Maintenance charges, which include renewal of parts, labor, and all costs, except the cost of energy, which depend upon the hours of burning. (c) The cost of energy, which depends upon the hours of burning and the rate charged. If data are compiled under these heads in convenient units, such as in (a) an annual charge, in (b) a charge per 1,000 hours operation, and in (c) a charge per 1,000 hours operation at unit cost of energy, the several items may easily be calculated for any given set of conditions and the total annual operating cost of any lighting system obtained as their sum. Aside from the items which may be classified under illuminating power, and cost, there are certain features which the illuminating engineer must recognize in selecting a lighting unit. As examples of these may be mentioned the operation on fluctuating voltage or pressure, the possibility of protecting the units and circuit against over voltage, the likelihood of outages and their influence on production, the general effect of the illumination, and the adaptability to artistic treatment.

The discussion was opened by Norman Macbeth, who commended the general plan outlined in the paper, but expressed the doubt that the information desired could be brought together for comparative purposes. He said that for commercial reasons the question of illumination should not become a question of the relative merits of two illuminants. Mr. Macbeth took exception to considering depreciation of permanent parts and regular attendance of illuminants under fixed charges as these he held logically come under maintenance charges.

S. W. Ashe expressed the opinion that in compiling data along the lines suggested in the paper trouble would be encountered in reducing it to a tangible comparable form. The incandescent electric-lamp industry is now standardized and it would be hard to obtain data regarding other types of illuminants that could easily be compared with incandescent lamps. Mr. Ashe said, further, that the laboratory performance of lamps should be the starting point for all comparisons and that the question of efficiency should be kept separate from questions of color value, esthetic conditions, etc.

R. B. Hussey recounted his experiences in collecting data on various street-lighting installations. He said that fixed charges could be compiled more easily on a yearly basis and maintenance and energy charges on an all-night, every-night schedule.

E. R. Eichengreen, speaking of the determination of illuminating power, held that it is more advisable to use minimum flux than average or maximum flux. He also stated that a fixed depreciation factor should be taken, this in his work being fifty per cent, for gas lamps.

G. A. Stickney held that the paper is decidedly important in that it suggests a plan of campaign that can eventually be followed with success. Speaking of the classification of cost data, Mr. Stickney said that it is difficult sometimes to determine definitely under which head the charges should be placed and on this account it is advisable to have the classification flexible so as to meet various conditions.

R. F. Pierce said the proper activity of the engineer has to do mainly with economy and this should be kept in mind in comparing illuminants. He added that the lack of data on illuminants at present is due to the difficulty of evaluating the various factors rather than to a hesitancy on the part of the manufacturers to divulge such information.

J. R. Cravath emphasized the importance of the question as to whether minimum, average or mean values should be taken as the illuminating power of a source of light. He mentioned installation where minimum illumination was desirable under certain conditions.

Mr. Harrison closed the discussion agreeing with Mr. Macbeth that the cost of cleaning long-life lamps should come under maintenance charges and be dependent upon the hours of burning. He agreed with several of the other suggestions made and said that if an editing committee could be appointed to consider the various data received many manufacturers who have such data available could be induced to submit it to the Society.

The report of the committee appointed to consider the president's address was then presented by J. R. Cravath, chairman. The address was highly commended and recommended to the consideration of every member. E. P. Hyde proposed a resolution requesting President Kennelly to appoint a research committee along the lines suggested in his address.

The paper by Preston S. Millar and L. J. Lewinson, entitled, "The Evaluation of Lamp Life," was then presented by the former.

EVALUATION OF LAMP LIFE.

This paper discusses the so-called conventional method of evaluating lamp life, calling for a determination of life to eighty per cent candlepower or earlier failure. The many disadvantages of this method are pointed out and a method proposed whereby more accurate and satisfactory results can be obtained. The chief disadvantage of the eighty-per-cent criterion is that it assigns exaggerated importance to elements believed to be of lesser value, as a result of which other more important elements fail to receive due recognition. Among minor disadvantages, the method attributes no value to the service of the lamp after it has depreciated in candlepower more than twenty per cent, notwithstanding that in some classes of service this portion of the lamp's life, though less efficient, has some value. Another disadvantage under which the method sometimes labors is the neglect of the candlepower-maintenance element when candle-hours are not figured and when reliance is placed upon the life factor alone. Also inaccuracies have been encountered due to difficulty in determining precisely the hours corresponding to a twenty-per-cent candlepower depreciation. In such work it is customary to determine the candlepower of a lamp at intervals and by plotting a curve through the points so determined, to ascertain the time when the candlepower curve crosses the eighty-per-cent candlepower line. Photometric errors of one or two per cent, quite likely to be encountered in commercial work, may lead to inaccuracies in the "eighty-per-cent life" of as much as five or ten per cent. Several examples illustrating these disadvantages are given. In the new method, suggested by the authors, it is proposed that lamps be evaluated in terms of their lumen-hours or candle-hours per watt throughout the test period divided by the hours in such period. The important matter to be decided before the proposed method evaluation can be applied is the selection of a test period. For any one size and type of lamp the test period should be adopted after careful consideration of normal performance. It should cover the useful portion of the life and should be so selected as to serve the purposes of the parties interested in the test. Where no superior basis of judgment offers, it is suggested that the test period be the average of (1) the hours at which the candlepower of surviving lamps has declined twenty per cent, and (2) the hours at which the mortality aggregates twenty per cent. Having arrived at a test period by this method, it is proposed that the lumen-hours or candlepower-hours of the lamp during the period be divided by the hours in the period, and that the resultant mean value throughout the period be considered the measure of the value of the lamp throughout useful life. On this basis a lamp which failed half way through the test period would be given substantially half value. The measure so obtained would be a true measure of the performance of the lamp (neglecting watts) and would be as nearly a true criterion of the value of the lamp as the correctness of the selection of the test period might permit. Several examples demonstrating this method are given.

This paper was briefly discussed by E. J. Edwards, J. W. Howell and Ward Harrison. Mr. Edwards said that the

worth of a lamp to a customer cannot be measured by the candle-hours it gives. The useful life he said was of more importance and he upheld the eighty-per-cent method of evaluating lamp life. He asked how candlepower-hours per watt is determined, also, what difference in penalty is applied to early burn-outs with the two methods.

Mr. Howell spoke of the importance of the paper and of its revolutionary character. He suggested that it be referred to a committee to be considered. He added that it occurred to him that the termination of lamp life by candlepower is a natural one, while termination by hours is an arbitrary one.

Answering Mr. Edwards' questions, Mr. Miller said that candlepower-hours per watt is the candlepower per watt times the hours the lamp burns. Regarding penalization for burn-outs Mr. Millar said that there is no difference between the two methods.

E. P. Hyde moved that the paper be submitted to the standardization committee which shall be empowered to appoint a sub-committee to consider the question and if the proposed method be approved it should be referred to other technical societies for action.

The paper entitled, "Photometry of Large Light Sources," by G. H. Stickney and S. L. E. Rose was then presented by the latter.

PHOTOMETRY OF LARGE LIGHT SOURCES.

This paper describes, briefly, some methods and elements of photometric construction which have been successfully applied in the illuminating-engineering laboratory of the General Electric Company. Various types of photometers are first discussed, these being all of the distribution type. Three different forms of distribution photometers are considered, namely, the constant length, the constant intensity and constant-radius photometers. In addition to these the paper describes a photometer used in the electrical testing laboratories; one used by Professor Matthews at Purdue University and several special types. In the General Electric Company's laboratory, practically all measurements have been made with two forms of photometers, namely, the single-mirror crane-type photometer and the twin-mirror photometer. Three classes of candlepower standards are used, namely, reference standards, substitution standards and working standards. Reference standards consist of carbon incandescent lamps with a parallel-type filament furnished by the Electrical Testing Laboratories of New York City and verified by the Bureau of Standards at Washington. New reference-standard lamps are purchased at frequent intervals and interchecked with the older ones and with each other. These lamps are burned for only very short periods of time, and great care is taken not to apply a higher voltage than called for on the calibration. Substitution standards consist of 250-watt or other high-candlepower multiple tungsten lamps, carefully seasoned and checked against two or more reference standards and against each other, without the use of mirrors. Working standards consist of forty-watt multiple tungsten lamps of special design furnished by the Electrical Testing Laboratories. These are checked against the substitution standards. Calibration tests are made frequently—at least once a week, and, in some cases, daily. When the standards show any discoloration or change in candlepower they are discarded. The methods of test are described and record sheets used by the General Electric Company reproduced. The paper concludes by pointing out the following as some of the more important details to which too much attention cannot be paid in order to eliminate all possible sources of error, both in calibrating and testing. A sufficient number of screens and proper placing of them to prevent stray light from reaching the disk in the sight box or the observer's eyes should be provided. Especially where very powerful lights are to be measured, it is important to watch every possible source of stray light. The sight box and standard lamp should be kept as free from vibration as possible. All meters should be carefully calibrated; for example, a one-per-cent error in voltage may result in a five-per-cent error in candlepower or even more. Meters of proper capacity should be used. If possible, meters of such capacity that the needle is about the center of the scale should be used. For alternating-current work, the proper frequency should be held constant during the test. All distances should be measured with an inextensible scale, such as a steel tape. A large error in candlepower may be introduced by measuring distances with a linen tape which has become stretched, or other scales which have become distorted. Standard lamps must be accurately set up; when stationary, a certain definite position with relation to the photometric disk must be maintained. Pressure leads must be extended direct from the voltmeter or wattmeter to the point at which it is desired to measure the voltage. Readings must be taken only when the lamp is operating at correct adjustment. In any photometer in which the light strikes the disk at a perceptible angle, care must be taken to make sure that the relation of the angle of view in the sight box does not affect the results.

The discussion on this paper was deferred until the afternoon session.

AFTERNOON SESSION.

The afternoon session was called to order by Vice-President Lansingh at 2:15. The discussion of the paper on "The Photometry of Large Light Sources," was opened by P. S. Millar who critized the design of the photometer and asked some questions. The use of a mirror simplifies the reading but does not give all the facts. He considered automatic recording devices desirable for fluctuating sources, and integrating photometers very necessary where total flux was required as in testing different forms of electrodes.

H. E. Ives thought changes in color and intensity could be eliminated in obtaining relative distribution curves by using the same source as a companion lamp, combining the light from several directions by mirrors for this purpose.

W. J. Cady spoke of the errors arising with color charges due to the variation of selective obsorption of the mirrors with color. The variation of the reflection coefficient is from 82 to 95 per cent.

W. F. Little advocated a large number of snap readings in preference to a few taken with greater deliberation. He did not consider the Lummer-Brodhun screen as suitable for this work as the Bunsen or Leeson disks.

F. H. Gilpin described the disk and mirror used in gas lamp comparisons by the United Gas Improvement Company.

A. S. McAllister approved of the method used by the authors. With focusing reflectors it is very necessary to give the results as apparent candlepower at a stated distance. If a constant distance is maintained in integrating the values over the entire sphere, a correct determination of the mean spherical candlepower is obtained.

G. H. Stickney closed the discussion by answering various points raised by the other speakers. He stated that great trouble had been experienced with the sectored disk, using alternating current, especially with a flicker photometer. It was necessary to avoid synchronism. The Lummer-Brodhun photometer had been chosen after careful tests with various forms.

The next paper was one by Louis Bell, on "Photometry at Very Low Intensities." In his absence, it was abstracted by E. P. Hyde.

An abstract of this paper, together with the discussion will be included in our final report in the next issue.

Preventing Misrepresentation.

The constant reference in newspapers to fires "probably caused by electric wiring" has so stirred up the contractors in one locality that they are taking steps to counteract the influence of such articles.

Their plan is to have a competent man investigate each rumor of this kind and give the papers the actual facts in each case. This will probably show that many, if not most, of these rumors are absolutely without foundation.

Ornamental Lighting in Fort Wayne.

The City Council of Fort Wayne, Ind., has adopted a composite design of ornamental cluster lighting posts. The column is a Doric one surmounted by the simple capital which characterizes this order of architecture. The cross arms afford room for four twelve-inch Alba globes.

American Electrochemical Society.

Twentieth General Meeting at Toronto, Canada, September 21, 22 and 23.

The American Electrochemical Society completed its tenth year of conventions with a meeting held in Toronto, Ontario, September 21, 22 and 23. While the attendance at this meeting was not as great as at some previous ones, any lack of numbers was more than made up by the interest of the papers presented and by the excellent and most enjoyable arrangements made by the local committee for the entertainment of the visitors. Toronto hospitality has gained a reputation which will last in the memories of those who were present. The total registration at the convention was 120.

On Thursday, the first day of the convention, two sessions for the reading of papers were held in the Chemistry and Mining Building of the University of Toronto, lunch being served in the East Hall of the Main Building in the middle of the day. The opening session was called to order by President W. R. Whitney at 10:40 a. m., and, in the absence of Secretary Richards, who had been detained in Europe, Carl Hering was elected secretary *pro tem.* Secretary Richards arrived at the convention in time to participate in the Friday session.

The first paper presented was one by T. D. Robertson, on "Recent Progress in Electrical Iron Smelting in Sweden."

ELECTRICAL SMELTING IN SWEDEN.

This paper consists mainly of a description of the furnace at Trollhättan for smelting iron ore, a report on which appeared in the last issue of the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN. The thermal efficiency is close to that of the Swedish charcoal blast furnace and higher than that of the English blast furnace. The maximum power is limited to 1900 kilowatts and to avoid overheating the electrodes the current must not exceed 17,000 amperes. The percentage of carbon in the pig can be controlled by adjusting the charge. Excellent steel has been made from low-carbon pig and scrap. The Trollhättan furnace was shut down at the end of May of this year in order to make certain alterations suggested by the results of its six months' operation. It is now possible to obtain cylindrical electrodes of 600 millimeters diameter, fitted with screw joints. These have recently been installed and result in two considerable improvements, the first one being that the loss due to stump ends is done away with; the second is that the electrical contact can be made at the point where the electrode enters the roof, in this way saving about 40 kilowatts, which with the old arrangement was lost, due to the resistance of the whole length of the electrode through which the current had to pass. The other important alteration is in the gas-circulating arrangement. The old dust-catcher was not very effective, as only very fine dust is expelled from the furnace. A water-scrubber takes the place of the dust-catcher, and a fan on the ground floor blows the cleaned gas into the furnace. At the present time the following "Electrometall" furnaces are either working or in course of erection:

	Horsepower
Sweden—Trollhättan, one furnace	3,000
Domnarfvet, one furnace	4,000
Hagfors, two furnaces (3,000 each)	6,000
Norway—Tyssedahl (Hardanger), two furnaces (3,500 each)	7,000
Arendal, two furnaces (2,500 each)	5,000
Total power	25,000

In the newer furnaces, three-phase current is used, and by means of three single-phase transformers, low-tension current is furnished to six carbon electrodes. Owing to the recent improvements in electrode manufacture and furnace design, it is now possible to construct units up to 6,000 horsepower which it is expected will work for two years without serious repairs to the hearth. Rather more than three metric tons of pig iron are produced by the electric furnace per electrical horsepower-year, using one ton of charcoal for the reduction of the ore. The blast furnace uses about three times this amount of fuel per ton of iron. The furnaces in Norway have a somewhat different form of shaft, as coke is the fuel employed for smelting. The volume of the shaft is smaller, but its diameter is greater, than the corresponding shaft of a charcoal furnace. The coke in the charge gives a greater conductivity, so that a lower tension has to be used. The comparative costs of electric and blast-furnace smelting depend in general on the cost of suitable fuel and electrical energy, as the electric furnace simply substitutes one electrical horsepower-year for two metric tons of blast-furnace fuel. In Sweden there is no doubt that the electric furnace has come to stay on account of cheaper production. The electric furnace is especially adapted to smelting finely divided ores.

This paper was discussed by Messrs. Brady, Simpson, Kohn, Handley, Hering and Lidbury, interest centering in the method of washing furnace gas, the necessity for using this gas to cool the roof of the furnace, and the temperatures of the gas at the bottom and top of the shaft. It was stated by Mr. Simpson that English buyers of Swedish electric pig iron find it irregular in composition. In reply to questions, Mr. Robertson said that considerable trouble had been experienced with the gas scrubber, but improvements were now being made which would render it satisfactory. The use of the gas was considered very important, in order to make the furnace last for a considerable time. A temperature of about 500 degrees centigrade is found about half way up the shaft and reduction takes place as low as 300 degrees. The pig iron sold in England was probably from some other small furnace and the blast-furnace pig from Sweden is irregular in quality. There has been no trouble in obtaining pig iron with carbon as high as four per cent and as low as two per cent.

The next paper on the program was one by Walter L. Morrison entitled, "Electric-Furnace Treatment of Nickel Ore and the Development of a Commercial Process." This paper was not read at the meeting, but an abstract of it will be found elsewhere in this issue.

A paper entitled "Note on an Unsuccessful Furnace Experiment" was then read by Francis A. J. FitzGerald.

UNSUCCESSFUL EXPERIMENT.

This paper discusses the reasons for low efficiency in a furnace described at the last meeting. The heat losses were excessive, although the furnace did the work for which designed. The furnace was compared experimentally with others of different construction. It was found that in the poor furnace, the ratio of surface to power expended was larger than in good furnaces. The surface considered is that exposed to radiation from the resistor in which the heat is developed, excluding the hearth which is useful area. The principal fault was in the poor heat insulation of the walls. This was shown by the fact that when equilibrium had been reached, the interior surface of the furnace was about 200 degrees centigrade cooler than the resistor. The ratio of hearth area to total area receiving radiation was lower in the inefficient than in efficient furnaces. The furnace was much improved by adding a layer of heat-insulating brick on the outside. The author does not consider an air gap in the wall of value, since the poor furnace had this.

A written discussion which had been presented by R. M. Thompson, who had collaborated in the design of the furnace, was read by F. A. Lidbury. He stated the condition which affected the losses in the inefficient furnace was that the electrodes interlocked and the outer side of the resistor was in contact with the surrounding brick. He did not agree with the author's conclusion regarding an air gap, but considered that one reason that air gaps did not always fulfill their purpose was that it was hard to get an air-tight space.

A paper was then presented by C. V. Slocum on "Titanium in Iron and Steel."

TITANIUM IN IRON AND STEEL.

Titanium alloy-steel was first made in 1903 by Rossi by use of an electric furnace, and is now widely used. A small amount of titanium is beneficial to both iron and steel on account of its strong deoxidizing properties and its effect of making the slag more fluid. It has been stated that car-

bon-free alloys dissolve more readily in steel, but the author finds no difficulty in using 5 to 8 per cent of carbon. The presence of aluminum has given difficulty. The titanium should be added just before the steel is poured. The cost of treatment with titanium varies from $0.25 to $2.00 per ton of steel.

R. Moldenke sent in a written discussion, which was read by F. A. Lidbury. He stated that the properties of the steel were masked by the presence of occluded gases and dissolved oxides, and that titanium remedied this condition. It is not necessary that the titanium remain in the steel and it is best not to have it in the pig iron, but to add it to the ladle before pouring.

Hans Goldschmidt also submitted some written discussion, which was read by Mr. Cuntz. He stated that the carbon-free alloy had been largely used and is very satisfactory. The alloy marketed by him contains aluminum and low carbon, and was used with great satisfaction, whereas the high-carbon alloys were used with difficulty. Twenty-four per cent of aluminum was the best proportion.

F. A. J. FitzGerald stated that his work was not in accord with that of Mr. Goldschmidt, but he agreed with the author of the paper.

Mr. Waterhouse also agreed with Messrs. Slocum and FitzGerald and spoke of his work in using high-carbon alloy without trouble.

The next paper was one by A. J. Jones, entitled, "Transforming Stations of Niagara Electrochemical and Electrometallurgical Industries." This paper will appear in a later issue. In discussing it, F. A. J. FitzGerald called attention to the fact that the circuit-breakers used in such installations often had to be of much larger capacity than the plant which was served, owing to the enormous power which was back of the line. He said that sufficient space was very often not given to the apparatus in connection with electric-furnace work. A. P. Saunders also spoke in appreciation of this paper.

E. F. Northrup called attention to the fact that, although the currents used in these plants were on a titanic scale, there were none so large that they could not be measured by the mercury form of ammeter which he had designed. He referred to one of those instruments in use by the Aluminum Company of America, which had a capacity of 16,500 amperes.

The next paper was by E. T. Dittus and R. G. Bowman, entitled, "The Direct Production of Molybdenum-Steel in the Electric Furnace." In the absence of the authors, this paper was abstracted by E. F. Roeber.

MOLYBDENUM STEEL.

Experiments are described for the production of molybdenum-steel direct from iron ore and molybdenite, a sulphide of the metal, in the electric furnace. To remove the sulphur, ferro-silicon is used, forming a sulphide of silicon, which passes into the slag. All ingredients were crushed, the hematite being smelted with coke and lime, the ferro-silicon and molybdenite being mixed and added to the bath of metal shortly before the reduction is complete. Analysis of the ingredients and of the molybdenum-steel are given. The electric furnace had a capacity of two kilograms of charge or about one kilogram of steel. The lining was magnesite and the walls of firebrick, encircled by steel bands. The base could be used as one electrode, and two graphite electrodes were suspended from above with mechanism for adjusting the height and position. The arc was sometimes maintained between these two electrodes. Asbestos washers encircled the electrodes where they passed through the cover. It was found preferable to use the iron electrode, imbedded in the base, connecting the two graphite electrodes in parallel. Sixty-cycle current was stepped down by transformers to 25 volts, and about 250 amperes were used. Molybednum-steel of low sulphur content was readily obtained, so the authors considered the method a success. They conclude that a tilting furnace is preferable to a stationary one, that tar is not a satisfactory binding material for crushed magnesite, and that the tap hole on a stationary furnace should be short, with a steep inclination. Ample provision for heating the tap hole should be made.

This paper was discussed by Messrs. FitzGerald, Hansen, Whitney and Hering, the first named stating that the conclusions were hardly warranted on account of the small size of the charge and furnace used.

The paper by Albert Hiorth, entitled, "Design of a Thirty-Ton Induction Electric Furnace," was, in the absence of the author, abstracted by Carl Hering.

THIRTY-TON INDUCTION FURNACE.

The design is based upon the data and results obtained with the five-ton furnace in Jossingfjord, Norway. The two most important things to be determined were the power-factor and the power required to keep the charge at the working temperature. The power-factor depends upon the design and the frequency of the supply. The voltage necessary to overcome the resistance depends upon the primary circuit, the core loss and the resistance of the bath. The latter is influenced by dimensions, conductivity of material and skin effect. The inductance depends upon the magnetic reluctance, the magnetic leakage, and its effect is proportional to the frequency. It will increase with the diameter of the cores. Performance curves are given for the five-ton furnace, and the computations are based upon these. Reasons are given for the various elements of design, and the results are given in the table.

M. Unger sent in a written discussion in which he stated that the power installation with low frequencies was very costly and that there would be a gain in combining a number of small units in one furnace rather than in making a single large unit. A higher power-factor would thus be secured. The secondary circuits should be increased from three to four or six. With 7.5-ton units the power-factor would be raised from fifty to sixty-one per cent at eight cycles, or to forty-four per cent at twelve cycles. The radiating surface would be the same. With a six-ring, thirty-ton furnace operating on a three-phase circuit at eight cycles the power-factor would be seventy-five per cent; at twelve cycles it would be fifty-nine per cent. This would make the cost higher for the furnace, but there would be a great saving in the power equipment.

Answering a question by Mr. Waterhouse, Mr. FitzGerald stated that he thought a Röchling-Rodenhauser furnace was superior to the other types of induction furnace.

Carl Hering spoke of his computations for a furnace which should have the least possible surface per unit of capacity. This shows a great improvement in the energy consumed, and he thinks as low as ten kilowatts per ton can be reached.

AFTERNOON SESSION.

The afternoon session was opened by an address by T. G. Gibson, director of the Bureau of Mines at Ottawa, on "The Mineral Resources of Ontario." He spoke in some detail of the different

DESIGN OF FURNACE.

	Old Furnace.	New Furnace.
Total Capacity	5 tons.	30 tons.
Capacity per leg	2.5 tons.	10 tons.
Diameter of bath	2.1 m.	3 m.
Width of bath	20 cm.	30 cm.
Depth of bath	27 cm.	45 cm.
Total surface of masonry	55 sq. m.	110 sq. m.
Total length of platform	8¼ m.	13 m.
Total width of platform	5¼ m.	6.5 m.
Sectional area of core per leg	1800 sq. cm.	1200 sq. cm.
Weight of core	15 tons.	23 tons.
Number of primary turns per leg	15	13
Sectional area of primary windings	1000 sq. mm.	4000 sq. mm.
Weight of copper per leg	0.875 tons.	4.5 tons.
Total weight of copper	1.75 tons.	13.5 tons.
Energy used	250 kw.	700 kw.
Copper losses	12.3 kw.	50 kw.
Iron losses	18 kw.	18 kw.
Power-Factor	0.65	0.50
Voltage	250	230
Periodicity	12½	8
Amperes per phase	1400	3540
Kind of current	1 phase.	3 phase.

kinds of ore and other mineral resources which are available in Ontario, calling special attention to the large silver output at Cobalt and the nickel production at Sudbury, the latter being the principal source of nickel in the world. He also spoke of the application of electric refining to copper, nickel, lead, iron, salt, etc. In conclusion, he suggested two problems for the attention of the electrochemist, a method of utilizing corundum for the production of aluminum and the recovery of potash for fertilizer from feldspar, which is very plentiful. He also spoke of the need of a method for cheaply extracting cobalt from the ore. At present this is obtained as a by-product from the mines faster than it can be utilized, and it is almost worthless.

W. R. Whitney called attention to the fact that cobalt brings about eighty cents per pound and that it should be much cheaper if it could be easily extracted from the residues.

The next paper was by Ching Yu Wen and Edward F. Kern, and was entitled "Effect of Organic and Inorganic Addition-Agents Upon the Electrodeposition of Copper from Electrolytes Containing Arsenic." In the absence of the authors, this paper was abstracted by W. D. Bancroft.

EFFECT OF ADDITION-AGENTS ON THE ELECTRODEPOSITION OF COPPER.

In the production of good and pure copper by electrolysis, the composition of the electrolyte is one of the important factors. The causes of poor copper deposits are chiefly the impurities which accumulate in the electrolyte, and which, under usual conditions, are precipitated along with the copper. Of those impurities, the most harmful and troublesome ones are arsenic and antimony, the presence of which in the deposited copper makes it brittle and nodular. It has been a known fact that during electrolysis part of the arsenic and antimony contained in the anode dissolves and remains in solution. These two elements, especially the arsenic, are allowed to accumulate in the electrolyte till a critical point is reached, which has not yet been definitely determined. When this point is passed they begin to be deposited with the copper on the cathode and render the deposit impure and brittle. To prevent this it is therefore of utmost importance to maintain the electrolyte within a certain degree of purity, in other words, to keep the amount of arsenic and antimony in the electrolyte below the danger line. The object of the investigation was to prevent the deposition of arsenic and antimony on the cathode and to prevent the formation of dendritic trees. This was accomplished by adding certain agents to the electrolyte, sodium chloride and gelatine giving the best results. The electrolyte used was copper sulphate containing sulphuric acid, and the experiments were carried out in small beakers, the electrolyte being stirred. The effect of temperature was also investigated. The experiments are described in detail. Many other addition-agents improved the deposit, even arsenic acid under certain conditions. Of the inorganic agents, the salts of those metals standing high in the electromotive series are generally satisfactory. Gelatine, glue and tannin are beneficial, while peptone is detrimental.

W. L. Spaulding sent in a written discussion in which he spoke of the addition of sodium chloride in the bath in refining oepper. When arsenic was present to the extent of three pounds, only 0.01 per cent of chlorine appeared. The amount of arsenic was slowly increased up to eighteen pounds, and then only 0.005 per cent of chlorine appeared. There was a slime of Cu_2Cl_2 on the anode, while more arsenic appeared on the cathode than in the control runs.

The next paper, by H. K. Richardson and F. D. Taylor, on "The Conductivity of Mixtures of Copper Sulphate and Sulphuric Acid," was, in the absence of the authors, abstracted by F. A. Lidbury.

CONDUCTIVITY OF MIXTURES OF COPPER SULPHATE AND SULPHURIC ACID.

This paper gives data and curves showing the results of adding different proportions of copper sulphate to sulphuric acid. The results may be stated briefly as follows. The addition of copper sulphate increases the conductivity of the sulphuric acid when the amount added is less than three grams to 100 cubic centimeters. When the addition is just three grams the conductivity is not affected. When more than three grams is added per 100 cubic centimeters there is a decrease in the conductivity. The conductivity of a mixture of equal parts of copper sulphate and sulphuric acid was about the same as that of the acid alone.

The next paper was by W. C. Arsem, entitled, "Transformation of Other Forms of Carbon Into Graphite." In the absence of the author, this was abstracted by C. A. Hansen.

TRANSFORMATION OF CARBON INTO GRAPHITE.

The conditions under which amorphous carbon is transformed into graphite have been much discussed and many statements made which are not supported by experiment. It has been stated by Moissan that a high temperature alone will produce the conversion, and by Berthelot that the carbon cannot be converted by heat alone, while Acheson claims that graphite is the result of intermediate formation and decomposition of carbides due to the presence of mineral matter. Previous experiments are discussed and a definition of graphite given as that allotropic form of carbon having a specific gravity between 2.25 and 2.26. Experiments were undertaken to show whether carbon could be transformed into graphite by simply heating at a high temperature and, if this is not the case, whether it is possible to cause the transformation by mixing with the carbon a quantity of mineral matter insufficient to form carbides with all the carbon present. In carrying out the experiments all samples were ground to a fine powder, packed in small graphite crucibles with tightly fitting covers, and then fired at temperatures over 3,000 degrees centigrade for fifteen minutes. The electric furnace used consists of a heater tube of Acheson graphite surrounded by an insulated carbon tube with annular free space between them. The samples were tested before and after firing by Brodie's method and the specific gravity also determined. The forms of carbon used were petroleum coke, bituminous-coal coke, anthracite coal, lampblack, retort carbon and diamond. All the pure forms of carbon tested reached a limiting density which is not appreciably raised by the addition of small amounts of mineral matter. The end product is graphite in some cases and not in others. Petroleum coke yields graphite while lampblack does not. Impure carbons show a similar behavior.

This paper was briefly discussed by Messrs. Lidbury and Hansen. The author's definition of graphite was questioned.

A paper on "A Small Electric Furnace with Heating Element of Ductile Tungsten or Ductile Molybdenum," by A. Winne and C. Dantsizen, was then read by the latter.

TUNGSTEN HEATING ELEMENTS.

The furnaces hertofore available for temperatures higher than the melting point of iron and in which substances can be heated out of contact with either carbon or oxygen are as follows: (1) The iridium-tube furnace. This is very fragile and expensive. (2) A carbon-tube furnace with porcelain tube inside. This is excellent, but calls for special transformers. (3) Platinum foil wound on fire clay or other refractory. This has been most generally used. Its limitations are the fact that the platinum is easily contaminated and the winding very expensive. (4) The Arsem vacuum furnace using a graphite heater. A crucible furnace and a tube furnace are described using ductile tungsten or molybdenum in the form of wire or ribbon. The high melting points and relatively low cost of these metals adapt them admirably to the purpose. The crucible furnace consists of a helix of the metal supported by an alundum tube and protected from oxidation by an atmosphere of hydrogen. The container for the charge is a small crucible placed inside of the alundum cylinder. This furnace can be safely run up to 1,700 degrees centigrade, using forty-five amperes at twenty-five volts. The tube furnace consists of a porcelain or alundum tube wound with metal foil. Around the tube is a tight metal casing filled with powdered silica and a hydrogen atmosphere is maintained in the casing. For a temperature of 1,600 degrees this furnace uses 14.3 amperes at eighty volts.

This paper was discussed by Messrs. Northrup, Hering, Saunders, Langmuir, Kohn and Snowden. In reply to questions, Mr. Dantsizen stated that the furnace would reach working temperature in 1.5 hours; that silica does not effect molybdenum, but that magnesia was just as suitable; that ductile molybdenum could now be had on the market; that other gases could be used to form an atmosphere around the conductor, such as carbon monoxide, but that carbon dioxide or illuminating gas could not be used. The flow of gas is so slow as not to affect the uniformity of temperature. No explosions had re-

sulted from the use of hydrogen. Sodium silicate could not be used as a cement with the ribbon, as it reacts with molybdenum. The cement used would stand as high a temperature as alundum. Mr. Saunders called attention to the fact that alundum was now being furnished with a glaze, so that it was not porous, and that it would stand a temperature of 1700 degrees centigrade.

The next paper was by E. F. Northrup, entitled, "New Data on Some Electrical Properties of Sodium, Potassium and Their Alloys."

CONDUCTIVITY OF SODIUM AND POTASSIUM.

This is the first of a series of investigations into the specific resistance and temperature coefficient of resistance of the metals. The metals used were commercially pure. They were melted and run into a glass tube provided with current and potential terminals. Pure mercury was used in the same tube and the results computed from the known constants of mercury. Resistances were measured with a Kelvin bridge. Temperatures were measured by a nickel resistance thermometer placed outside the tube, the whole being immersed in an oil bath. The temperature coefficients were all found to be linear above the melting points. Below the melting points they are nearly linear. Potassium, sodium and an alloy of equal volumes of each were found to increase abruptly in resistance at the melting point. The increase was 45 per cent for sodium between 93.5 and 96.3 degrees centigrade, 52 per cent for potassium between 60.4 and 63.2 degrees, 48 per cent for the alloy between 2.8 and 20.0 degrees. Curves are given showing the detailed values, as well as a table of observations. The principal results are shown in the table.

	Specific Resistance in Microhms. 20 deg.	100 deg.	Temperature coefficient solid	liquid	Density
Mercury.	95.78	103.6		0.0010	13.6
Sodium.	4.87	9.72	0.0053	0.0049	0.98
Potassium	7.12	15.3	0.0058	0.0051	0.87
Alloy.	33.8	37.9		0.0015	0.92

Sodium has three times the resistivity of copper, but as its density is only one-ninth as great, it is a better conductor per unit of weight, and could compete with copper at any price less than three times the price per pound of the latter. By inclosing it in iron pipes its use might be practical.

This paper was briefly discussed by Messrs. Whitney and Lloyd.

The paper by C. F. Burgess and J. Aston, entitled, "The Electrical Resistance of Iron Alloys," was, in the absence of the authors, presented by O. P. Watts.

ELECTRICAL RESISTANCE OF IRON ALLOYS.

Results are given of measurements on the relative resistivities of the various alloys of electrolytic iron whose magnetic properties have been given in previous papers. In the alloys of high magnetic permeability, desirable for use in electrical apparatus and machinery, it is desirable to have high resistivity in order to obviate large eddy currents. The property is also of importance in connection with wire for rheostats, etc. The resistances of the bars used were determined by measuring the drop in potential over a definite length while a known current was flowing. Different percentages of the alloyed element were used, and in some cases two or three metals were combined with the iron in a single alloy. Details of the composition and the measured values are given. The comparison bar of electrolytic iron has a specific resistance of 12.1 microhms per cubic centimeter. Annealing in iron generally causes a slight decrease in resistance. All of the alloys have a higher resistance than iron, although slight in some cases. Figs. 1 and 2 show some of the results. The experiments also included aluminum, antimony,

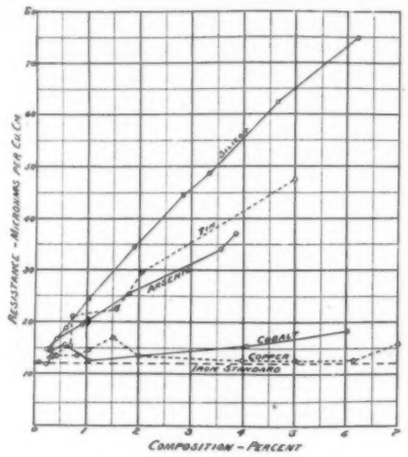


FIG. 1.

bismuth, lead, selenium, and silver. The alloys of arsenic, silicon and tin, all of which improve the magnetic properties, have a high electrical resistance, almost proportional to the quantity of the alloying metal. Alloys of nickel, chromium and silicon are suitable for high resistances. The change of resistance due to heat treatment generally follows the change of physical hardness, annealing decreasing the resistance, and quenching increasing it when-

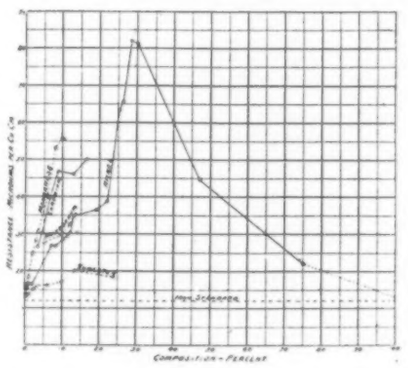


FIG. 2.

ever it has a hardening effect. High coercive force is usually accompanied by high resistance.

This paper was discussed by Messrs. Hansen, Northrup and Lloyd. In answer to a question, it was stated that all the bars used were forged; that the current used in measuring was not passed through the knife blades, but through auxiliary contacts, and that the measurements were made at room temperature.

The report of the committee which had been appointed by the president to consider the question of the reading and publication of papers presented before the society was then made by Chairman F. A. J. FitzGerald. This report recommended a higher standard of papers, the publication of a monthly journal by the society which should contain papers of only transient interest, and that only papers of permanent value and interest should be published in the *Transactions*. It was also recommended that a committee be formed to consider all papers presented and pass upon them before they were placed upon the program.

A report was also made by E. R. Taylor, who was appointed as a delegate of the society to the National Conservation Congress to be held in Kansas City, September 25, 26 and 27. Resolutions which had been drawn up by the committee in regard to the conservation of water power were endorsed by the society.

The session then adjourned.

In the evening a demonstration was given of the Evans-Stanfield electric furnace, by which process steel of high quality is made in one operation direct from titaniferous iron ore, such as is so common in Canada. This was followed by a smoker and entertainment arranged by Section Q, which was thoroughly enjoyed by all present.

Lieutenant-Colonel and Mrs. J. B. Miller tendered a reception in the afternoon to the members of the society and the visiting ladies, and in the evening the ladies were entertained at a theater party.

FRIDAY SESSION.

The session on Friday was held at the club house of the Lambton Golf and Country Club, a special train being run to the grounds from the city of Toronto. The first paper at this session was one by S. Dushman on "Electrochemical and Electrometallurgical Developments in Canada."

ELECTROCHEMICAL DEVELOPMENTS IN CANADA.

The author referred to the work that had been accomplished in lead refining, in the carbide plants at Merritton and Ottawa, the plants for ferro-silicon at Sault Ste. Marie and Welland, the plants for cyanamide and graphite at Niagara Falls, the plant at Chippewa, the refining plant at Ottawa, the plant for caustic soda at Sandwich, the aluminum and carbide plants at Shawinigan Falls and the phosphorous and ferro-phosphorous plants at Buckingham. The plant for making electrolytic alkali at Sault Ste. Marie has been discontinued. He then spoke of the possibilities for future development, which depended upon mineral resources, water power and transportation. He discussed the mineral resources of the country and in considering water power pointed out that 75,000 horsepower is now

developed in British Columbia, with the possibility of 50,000 more. In Ontario there is probably 1,000,000 horsepower available and including Quebec, New Brunswick, etc., there had been estimated a total of 16,000,000 horsepower available in the whole of Canada. There are now 25,000 miles of railroad in operation.

Alean Hirsch then read a paper entitled "The Preparation and Properties of Metallic Cerium."

PROPERTIES OF CERIUM.

Little has been done in studying the physical and chemical properties of the rare earths, on account of the difficulty of obtaining the metals. What metal has been obtained has usually been in small quantities and very impure. The field of alloys is almost untouched. Oxalates of the rare earths, obtained from monazite sand, formed the raw material. Thermal methods of reduction failing, the electrolysis of cerium chloride was resorted to with successful results, the ampere efficiency being thirty-six per cent. 380 grams were obtained with an expenditure of 600 ampere-hours at 15 volts. The vessel used was constructed of iron pipe. The metal was purified by preparing the amalgam and distilling off the mercury from a magnesia vessel at high temperature in a vacuum. The physical and chemical properties were investigated with metal 98 per cent pure. The atomic weight is 140.25; specific gravity, 6.92; specific resistance, 71.6 microhms per cubic centimeter; melting point, 635 degrees centigrade; tensile strength, 12,900 pounds per square inch; specific heat, 0.05. The metal is paramagnetic, malleable, ductile; it has high heat conductivity, high heat of oxidation, low thermal electromotive force against copper. The decomposition potential of normal cerium chloride in aqueous solution is 4.3 volts. Cerium burns when heated to 160 degrees centigrade. Many alloys were studied, those formed with platinum, tin, antimony, silicon, lead, calcium, zinc, cadmium, manganese, iron, nickel, tungsten and magnesium being pyrophoric, that is, they emit sparks when scratched.

This paper was discussed by Messrs. Parsons, Northrup, Brown, Hansen and Richards, who commended the work of the author and discussed the reasons for the pyrophoric properties.

The next paper was by Irving Langmuir on "Thermal Conduction and Convection in Gases at Extremely High Temperatures."

THERMAL CONDUCTION IN CASES.

Experiments made in studying the equilibrium composition of air in which nitric oxide has been formed in the presence of a Nernst glower, indicated a high value for the heat conductivity of the gas at very high temperatures. Common experience is that conduction and convection are the principal causes of temperature equalization at ordinary temperatures, but as the temperature increases it is thought that radiation very soon predominates. Few if any measurements of the heat conductivity have been carried on at temperatures above 400 degrees. According to the kinetic theory of gases the heat conductivity would increase with the 0.85 power of the temperature. The heat loss from the Nernst glower at 2,400 degrees varied as the fifth power of the temperature. As the total radiation varies as the 4.3 power, a previously unexpected phenomenon was indicated. The later experiments were carried out with tungsten wire in an atmosphere of hydrogen. The temperature was determined from the observed candlepower and also from the measured resistance of the filament. The energy required to heat the wire to any temperature is very nearly independent of the size of the vessel containing the hydrogen, but was about ten per cent less in a large brass tube than it was in the glass tube. The position of the wire in the vessel makes considerable difference at low temperatures but at high temperatures it has very little effect. The relation between energy consumption and temperature is given in Table I. The rate of flow of hydrogen had no effect on the energy consumption.

TABLE I. WATTS PER CENTIMETER OF LENGTH.

Temperature absolute	Wire A. Diameter 0.028 mm.	Wire B Diameter 0.45 mm.	Wire C. Diameter 0.229 mm.	Wire W. Diameter 0.069 mm.
1000	....	2.1	.....	....
1200	....	3.0	3.3	5.1
1400	....	4.0	4.4	6.9
1600	....	5.3	5.8	9.4
1800	....	7.1	8.0	12.9
2000	8.8	9.4	10.7	17.8
2200	11.2	12.2	14.1	24.8
2400	14.5	16.0	18.0	35.0
2600	20.0	22.2	26.6	52.7
2800	28.6	32.1	39.2	....
3000	42.4	48.0	59.5	....
3200	67.3	77.3	97.5	....
3400	....	136.4	175.	....

The loss of energy increases very rapidly with increasing temperature. The power of the temperature, N, to which the loss in watts per centimeter is proportional is given in Table II.

TABLE II. WIRE B.

Temperature absolute	Exponent N.
1000	1.86
1500	2.08
2000	2.71
2500	4.03
3000	6.90
3400	10.1

In a vacuum the loss is proportional to the 4.8 power of the temperature over a wide range, hence in the case of the wire B the ratio of radiated to total energy reaches a maximum at about 2,600 degrees absolute. The most reasonable explanation of the very high heat conductivity at the high temperatures is that the molecules dissociate close to the filament, thereby absorbing a large amount of heat. After diffusing away from the wire they recombine and give up the heat at the lower temperature Experiments are in progress to determine the energy loss in monatomic gases. The candlepower measurements indicate that the melting point of tungsten is above 3,450 degrees absolute.

This paper was discussed by Messrs. Hering, Northrup and Lloyd.

A paper by C. F. Hale, on "The Measurement of Very Small Gas Pressures," was then, in the absence of the author, abstracted by W. R. Whitney.

MEASUREMENT OF GAS PRESSURES.

The extension of studies of the phenomena in rarified gases to the region of very low pressures has made increasingly important the development of manometers whose indications of pressure are not dependent upon the use of mercury. Thus, with the modern rotary pump it is a relatively simple matter to evacuate glass vessels to a pressure of 0.01 millimeters of mercury, but if a McLeod manometer is employed to measure the residual pressure, the mercury in it contributes about ten per cent to the total pressure. Pirani devised a manometer depending on the fact that at low pressures the heat conductivity of gases depends upon the pressure. He used a tantalum or platinum lamp in connection with the evacuated vessel and measured the current at constant pressure. The temperature, and consequently the resistance, depended upon the pressure of the residual gas. This method was improved by the author by using a higher temperature of filament, decreasing the distance between wire and bulb, using a thin bulb and a high-resistance filament. A tubular bulb is used and it is immersed in an ice bath. A similar bulb is sealed off and kept in the same bath, the two being connected in adjacent arms of a Wheatstone bridge. Constant current is maintained, and the values of pressure in terms of resistance determined by a calibration by means of a McLeod gauge. Calibration must be with the same gas that is to be used subsequently since the readings depend upon the nature of the gas and upon the temperature of the bath. Reliable measurements may be made down to 0.00001 millimeter of mercury.

Joseph W. Richards, who had just arrived during this session, then abstracted his paper on the "Electrochemical Industries of Norway."

ELECTROCHEMICAL INDUSTRIES OF NORWAY.

The author had just returned from a visit to Norway, where the majority of the electrochemical plants in operation had been visited. The Anglo-Norwegian Aluminum Works near Kristiansand developed 12,000 horsepower from a sixty-foot flow of water and produced from 800 to 1,000 tons of aluminum per year. At a nickel refinery at Kristiansand the matte from copper and nickel ore is refined electrolytically. The copper-nickel alloy is used as anode and the nickel deposited upon lead. The Badische-Anilin Fabrik is making sodium nitrite by the Schoenherr process and is turning out 300 to 400 tons per year. Near Bergen the British Aluminum Company has developed 2,000 kilowatts and is making 600 tons of aluminum per year. At Badheim he found the sodium works shut down for lack of power. The works had been using only 100 feet of the available 1,000 feet fall of water, but are now preparing to utilize the entire fall, from which 2,500 horsepower will be secured. The Castner process is being used. At Udda the Peterson Carbide Works develops 20,000 horsepower and turns out 30,000 tons per year, of which 10,000 are utilized by the adjacent cyanamide works. This plant is to be doubled, the additional capacity being used for cynanamide, the latter being converted to ammonium sulphate for use as a fertilizer. In the same neighborhood the Tissa water power is to be used in working zinc ores electrolytically. The ore brought from Australia is roasted and the sulphur obtained utilized for ammonium sulphate in the works mentioned above. A resistance furnace is used for refining the zinc. The Hardanger Steel Works is also at Tissa and will make electric pig iron. The plant is now under construction and is expected to be ready in April. Each furnace will be fifty feet high and have six electrodes operating on two three-phase circuits. There will also be two steel furnaces. At Arendal two electric pig-iron furnaces of 4,000 horsepower each are being constructed by Eyde. He stated that power was being sold by a power company near Stavanger for $6.50 per horsepower-year. There is a plant at this point built especially to utilize old scrap in making steel and 3,000 to 6,000 tons per year are disposed of in this way. 240,000 horsepower are now being utilized for the fixation of atmospheric nitrogen; this represents an investment of $15,000,000. For small installations the Schoenherr process has been found most suitable, but for utilizing large quantities of power the Birkeland-Eyde is found to be superior. The latter is now utilized in 10,000-horsepower units.

A paper by Alfred Sang, entitled, "Galvanizing Wire in Zinc Dust," was, in the absence of the author, omitted.

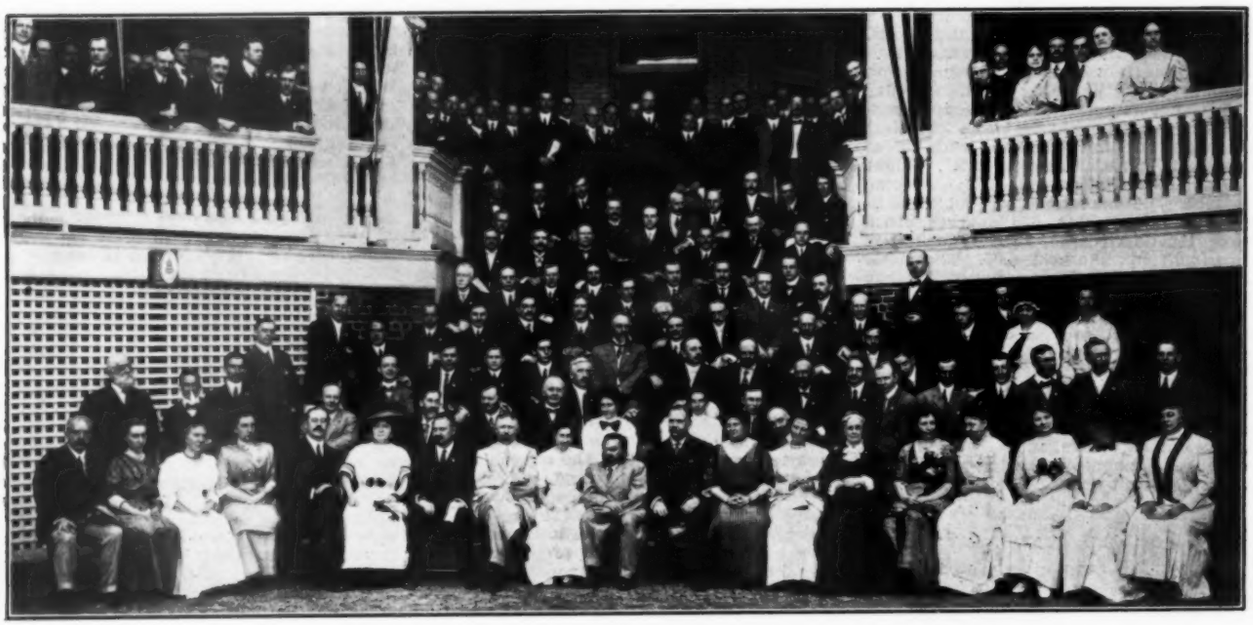
A vote of thanks was then moved and passed to the General Committee, the Ladies' Committee, Lieutenant-Colonel and Mrs. Miller, Professor Evans, the University of Toronto, the Lambton Club, the Canadian Westinghouse Company, the Steel Company of Canada, and the Hydro-Electric Commission for courtesies extended.

The committee on the Ferro-Boron prize reported that it had not been awarded because of the three methods presented; one was not a direct method, as required, and the other two were not considered worthy.

The session then adjourned and an excellent lunch was served in the club house, the afternoon being devoted to golf.

On Friday evening a banquet was held at McConkey's restaurant. Professor Ellis acted as toastmaster and responses were made by P. W. Sothman, W. R. Whitney, J. W. Richards, and Leo Balkeland.

On Saturday an excursion was made to Hamilton, where the plants of the Canadian Westinghouse Company and the Steel Company of Canada were inspected. Dinner was served at the Waldorf Hotel and in the afternoon a special car took the party to the Dundas switching station of the Hydro-electric Commission of Ontario. The entire 110,000-volt supply passes through this station, the current for Hamilton being transformed to 14,520 volts.



GROUP OF MEMBERS OF ASSOCIATION OF EDISON ILLUMINATING COMPANIES.

Convention of Association of Edison Illuminating Companies.

The twenty-seventh annual meeting and thirty-second convention of the Association of Edison Illuminating Companies was held at the New Monmouth Hotel, Spring Lake, N. J., on September 19, 20 and 21. Thomas E. Murray, of New York, presided. The meeting was the most largely attended in the history of the Association, there being about 300 persons present. It was an eminently successful meeting from all points of view. An interesting feature of the meeting was the presence as visitors of S. Z. de Ferranti, president of the Institution of Electrical Engineers, Charles Merz, Arthur Wright and Mr. Couvey, of London, England.

Extracts from some of the papers and reports presented will be given in a later issue.

The following were elected as officers for the ensuing year:

President, George H. Harries, Washington, D. C.

Vice-president, Arthur Williams, New York.

Treasurer, L. A. Ferguson, Chicago.

Secretary, H. T. Edgar, Seattle.

Executive Committee: Samuel Insull, Chicago; Charles L. Edgar, Boston; J. W. Lieb, Jr., New York; Joseph B. McCall, Philadelphia; W. W. Freeman, Brooklyn, and the officers, *ex officio*.

The entertainment features of the convention were well arranged and particularly enjoyable.

Steam Power for Peak Load.

The municipality of Lachine, Canada, utilizes an induction motor for operating the pump which supplies water and fire protection to the city.

Current is purchased by the year on a basis which is all right for lighting the city and for pumping at all times of the year except the three winter months, during which the lighting load is greatest. It was figured that operating the pump by steam for four or five hours a day during that period could be made less expensive than buying sufficient electric current to operate entirely by electricity. As further advantages of an auxiliary steam installation, the insurance rate could be reduced and the city could be better lighted without incurring unreasonable additional expense. It was, therefore, decided to arrange the pump for operation by a steam turbine during the peaks in the lighting load in winter and in case of accident in the electric line. Either driving unit can be thrown into or out of use instantly by means of clutches on the shaft.

Long Trip by Interurban Private Car.

The office car of H. E. Chubbuck, vice-president executive of the Illinois Traction System, recently completed a trip of remarkable length, over interurban railroads of Missouri, Illinois, Indiana and Ohio. The run amounted to 1,624.3 miles, and the car was the first to travel in the four states as named.

Central-Station Practice

Power-Plant Economies.

The introduction of a single inefficient unit in a series of mechanisms, designed to work in conjunction with each other, may nullify the entire scheme of design and offset all the economies effected by the efficient operation of the more carefully selected machines. Power plants are frequently offenders in this respect. Boilers, engines, turbines, and other large apparatus are selected with a view to developing a horsepower with the least expenditure of fuel, coal-handling apparatus is installed to reduce to a minimum the labor cost, stokers are placed under the boilers to obtain the most complete combustion of the fuel, feed-water heaters and economizers are used to extract as much heat as possible from engine exhausts and waste gases and return it to the boiler; in short, it would seem that everything had been done to make the plant a model. But somewhere in the chain there may be a leaky joint, an untrapped steam outlet, an inefficient pump or some other machine which is wasting more steam and, therefore, dollars, than is saved by all the efficient apparatus installed.

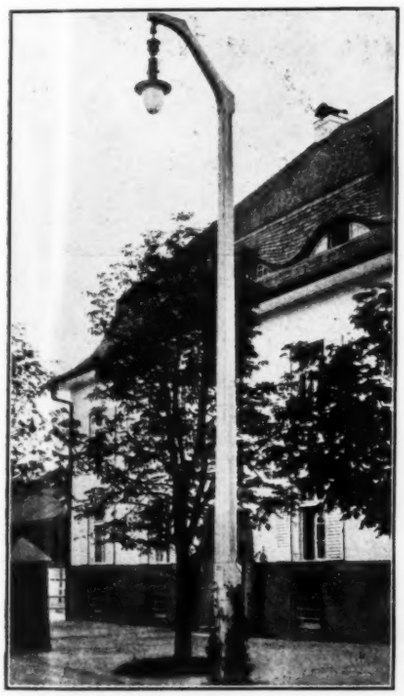


FIG. 1.—CONCRETE LAMP-POST AT MUNICH.

We have in mind a power plant where just such a case occurred. It was a well-designed plant, fitted with all the best devices for economizing fuel, including stokers, superheaters, feed-water heaters, etc. All drips were trapped, and it seemed that everything had been done to secure efficient operation. The engine was furnished under a guaranteed maximum water-consumption. After the plant was put in operation the fuel bills ran much higher than were anticipated. A boiler test showed that boilers and stokers were working well, and that a high rate of evaporation per pound of fuel was being secured. Naturally the engine was blamed for the excessive operating expense and the owner proceeded to exact the penalty from the manufacturers. A consulting engineer was called in to arbitrate the dispute, and after a careful investigation and an engine test, he discovered that the devices operating the stokers and furnishing the air supply for them were wofully inefficient and were using upwards of ten per cent of all the steam made by the boiler plant.

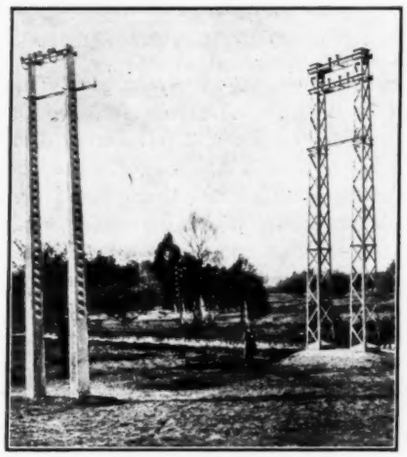


FIG. 2.—TRANSMISSION TOWERS.

The above, perhaps is an extreme case, but it illustrates the care that is necessary in the design of even the little details where a high over-all efficiency is desired.—*Industrial Engineering.*

Uses of Reinforced Concrete.

With reinforced concrete invading practically all of the structural lines, it was to be expected that it would find a wide range of applications in connection with electrical transmission lines, some of which have already been noted in our columns. (See issues of August 12, page 316, and August 19, page 376.) Still other types are shown in the illustrations herewith, of which one pictures a lamp-post with a curved top which partially conceals the cutout pulley used for switching the lamp into and out of circuit. Both the lead cable and the hoisting rope pass down through the bore of the tube, the lamp being raised and lowered by a windlass set into the post a few feet above the base.

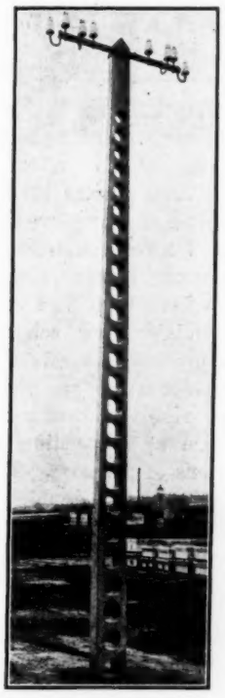


FIG. 3.—TRANSMISSION POLE NEAR LEIPSIG.

The illustration of the concrete transmission tower used in connection with the "overland circuits" of the central station at Reichenbach (also in Germany) shows a noteworthy contrast, as the tower at the other side of the road is of latticed steel. Both towers were designed to stand the same

strains and be of the same effective dimensions, *viz.*, a height of 46 feet over all or 37.5 feet above the ground. The cost of the latticed-steel tower, set in its concrete foundations, was $134, while its reinforced-concrete rival set in place cost only $25.

The transmission pole used near Leipzig is one of a type now rapidly growing in popularity in Germany. The illustration shows it with the perforations reaching all the way to the ground, for ease in climbing, but the same type is often built with the lower seven feet unperforated.

Another novel use of reinforced concrete is as a housing for underground transformers, sixty of the type shown being lately installed by the electrical works of the city of Hanover. The same illustration also shows a sectional form of concrete underground conduit made with telescoping ends and flat bottoms.

Storing Exhaust Steam.

An exhaust-steam storage tank partaking of the form of a gas holder, but for the same use as the so-called exhaust regenerator employed as an intermediary between a reciprocating steam engine and a low-pressure steam turbine, has been built at a colliery in Cologne. In this new scheme there seem to be no trays for catching intermittent condensation of the steam, leaving the resultant water ready to deliver steam at succeeding momentary reductions of pressure. The steam storage holder has a double wall for heat insulation. The holder proper is twenty-one feet high and twenty-seven feet in external diameter, and is covered with the form of movable bell top, usual with gas holders, the bell top being twenty-six feet high and twenty-three feet in diameter. The seal between the holder proper and the bell is of water, with a layer of oil in the top to prevent evaporation of the water. In order to minimize the loss of heat through the portions of the bell in contact with the liquid, the metal is cased with a double layer of boards and the rest of the metal surface exposed is covered with asbestos. The holder is employed in connection with a hoisting engine and it receives also the steam from a compressor. The exhaust is admitted into the holder from underneath at a middle point and passes through an oil separator before reaching the storage space. The supply of exhaust steam to the low-pressure turbine is taken also from the bottom of the holder. The rise and fall of the bell, of course, accommodates the steam as regards volume, and if the volume should become too great the bell automatically opens the safety valve. It is stated that with a bell capacity of 10,000 cubic feet of steam and a load of 500 kilowatts the whole of the exhaust steam from the winding engine during one lift can be accommodated, so that there is a minimum possibility of steam being wasted through blowing off. A test for the loss of heat of the holder was undertaken by filling the holder with steam and noting the time required for the bell to descend a definite distance. It was found that the rate of condensation was about one-half pound of steam per square yard of area per hour.—*The Iron Age.*

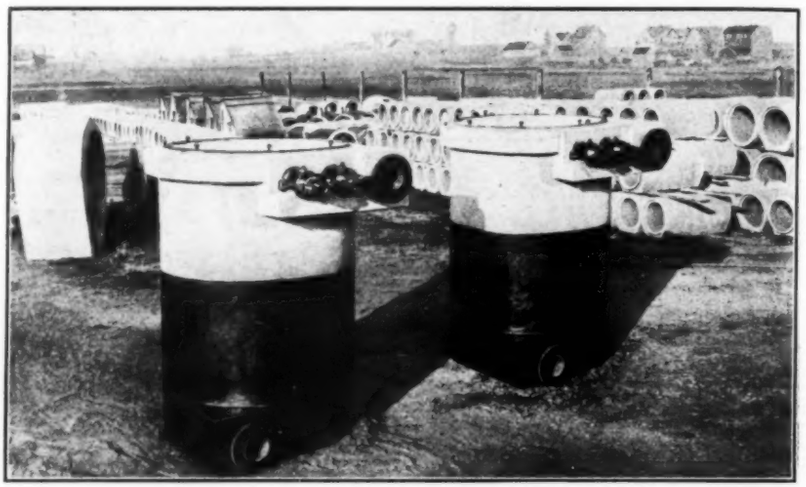


FIG. 4.—REINFORCED-CONCRETE CASINGS FOR UNDERGROUND TRANSFORMERS.

Commercial Practice—Management, Rates, New Business.

An Electric-Vehicle Opportunity.

While the hot period of July in New York was more severe than usual, the deaths of work horses due to the heat during those six days is a very strong argument in favor of the electric commercial wagon.

The health department of New York city, which has the task of removing dead horses, reported that during the six working days of the hot period 171 horses died each day—a total of 1,026.

These horses represented over half a million dollars cash value, which was entirely wiped out in a single week.

In addition to this the horses not affected fatally were able to work at scarcely half their normal capacity, and fully twenty-five per cent of the drivers' time was consumed in staving off sun-stroke by frequent applications of water and rests in the shade.

It is estimated that the money represented by the horses which died would pay for a sufficient number of electric vehicles to do all of the work done by the horses, and do it more efficiently and economically.

In New York City, where it is estimated that there are in the neighborhood of 50,000 draft horses, not less than four per cent die annually from the effect of heat in summer and slippery pavements in winter. This million-dollar annual loss is in addition to the normal deaths, and represents a tremendous increase in the cost of horsehaulage.

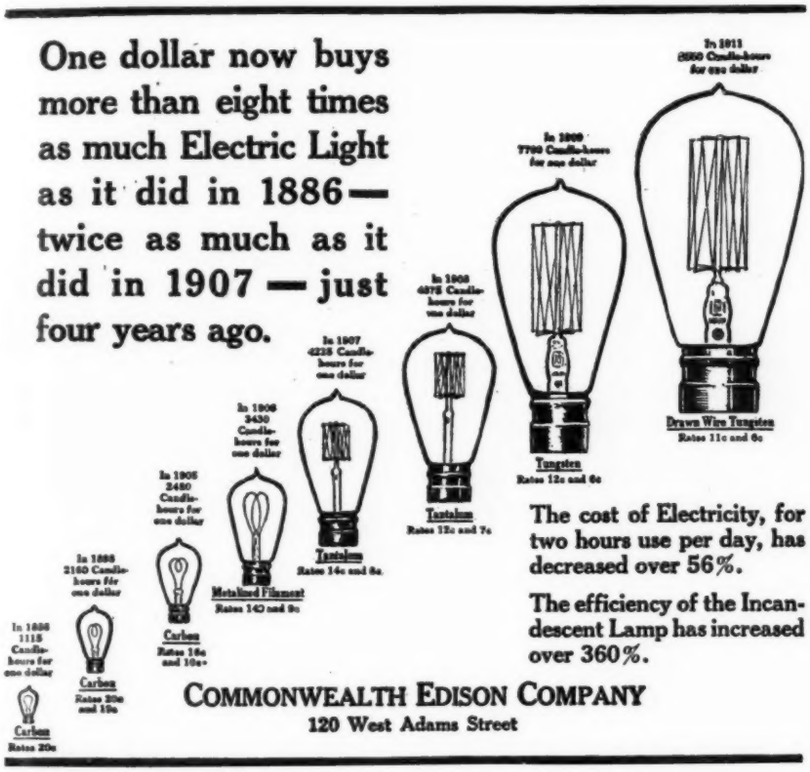
Brooklyn Edison Service Replaces Isolated Plant.

The sales department of the Edison Electric Illuminating Company of Brooklyn has just closed a contract covering the complete electric light and power supply to the new building of the Sternau Company, to be located on John Street, Brooklyn. The new building is concrete, ten stories in height and used entirely for the manufacture of the famous Sternau ware.

In the old factory of the Sternau Company an independent plant was used to supply light and power. This will be given up in the new building and Edison service exclusively will supply all the light and power needed.

A Graphic Advertisement.

The Commonwealth Edison Company, Chicago, Ill., is publishing in the Chicago daily press, the accompanying self-explanatory advertisement. The


One dollar now buys more than eight times as much Electric Light as it did in 1886—twice as much as it did in 1907—just four years ago.
In 1886 2160 Candle-hours for one dollar
Carbon
In 1905 2480 Candle-hours for one dollar
Carbon
In 1906 3430 Candle-hours for one dollar
Metalized Filament
In 1907 4225 Candle-hours for one dollar
Tantalum
In 1908 4975 Candle-hours for one dollar
Tantalum
In 1909 7790 Candle-hours for one dollar
Tungsten
In 1911 2650 Candle-hours for one dollar
Drawn Wire Tungsten
The cost of Electricity, for two hours use per day, has decreased over 56%.
The efficiency of the Incandescent Lamp has increased over 360%.
COMMONWEALTH EDISON COMPANY
120 West Adams Street

NEWSPAPER ADVERTISEMENT OF COMMONWEALTH EDISON COMPANY.

rates for energy in Chicago have steadily decreased in almost inverse proportion to the increase of customers, and, as graphically shown in the advertisement, the efficiency of the incandescent electric lamp has increased conversely with the decrease in rates.

This condition offers a double incentive for the use of electricity for lighting.

New Franchise for Pueblo Company.

The Pueblo & Suburban Traction & Lighting Company, of Pueblo, Colo., has been granted a new twenty-five-year franchise to conduct a railway and lighting business. One of the provisions of the new franchise provides for extensive additions to the traction system.

ELECTRIC HEATING AS APPLIED TO COOKING APPARATUS.[1]

BY HAROLD GRAY.

Electricity as a means of cooking has not come into the common use it deserves, nor the use which a cheap power supply and the conveniences of electricity seem to warrant. The factors which are not at first apparent must be considered to determine the true cause for this, and with this end in view the construction of the oven itself may be considered.

The essentials which bear on the success or failure of electrical cooking are: Reliability of the apparatus, efficiency of the apparatus, utility, i. e., good practical design to attain the object in view, cost of apparatus and cost of electrical energy, each of which will be taken up separately.

Reliability of the Apparatus.—The operators in the domestic field are generally unskilled in the engineering sense, often careless, and with small elasticity of mind. This being the case, it becomes essential that all apparatus passing through their hands must be (as far as external manipulation at least is concerned) of the simplest possible character combined with great robustness.

Immunity from breakdown is a most important consideration. A breakdown or failure to do its work in any piece of electrical cooking apparatus under ordinary treatment should be rendered practically impossible. A shock may so alarm the operator that she will decline to have anything further to do with electrical cooking. For this reason, if for no other, a regulation should be rigidly enforced that all apparatus should either be connected to a ground wire, or as a less satisfactory arrangement, rest on a grounded metal table.

Efficiency of the Apparatus.—Electrical cooking has to compete against gas cooking, and unless it can be shown in practical working to do this on an average basis, its success amongst the mass of the people can never hope to be attained. A comparison of the crude heat obtainable from gas and electricity for the same amount of money will here be of interest.

Assume gas to be 2s. 6d. (60 cents) per 1,000 cubic feet, and that it gives out 600 British thermal units per cubic foot, and that electricity is ¾d. (1.5 cents) per kilowatt-hour and gives out 3,400 British thermal units per kilowatt-hour.

Thus gas gives 600,000 British thermal units for sixty cents, or 20,000 for two cents, and electricity 3,400 British thermal units for 1.5 cents, or 4,532 for two cents.

At these assumed prices it will be seen that four times more crude heat is available for a given price with gas than with electricity. Under these circumstances the vital necessity for the highest possible efficiency which is reasonably obtainable in electrical cooking apparatus will at once be recognized in order to overcome the crude heat advantage which gas has over electricity at the prices instanced.

It will probably be admitted that 1.5 cents per unit is a reasonably low price for domestic power, and one cent the very lowest price which will be obtainable from any supply authority for a considerable time to come, and will, without doubt, be much lower than the average taken throughout this country for, say, the next ten years.

In considering the question of efficiency it is necessary to split up cook-

[1] From a paper presented before the Manchester (England) section of the Institution of Electrical Engineers.

ing work into two broad classes, boiling, frying, etc., in which the basis is the transmission of heat to a liquid such as water or fat, which may in turn heat some other food, and roasting, baking, etc., which is carried out in ovens and in which the basis is the application of heat energy to air which air passes heat on to the food to be cooked.

The obtaining of the efficiency of ovens is a much more difficult matter than that of the boiling and frying apparatus, owing to the high temperatures necessary.

TABLE I.

	Size of oven cu. in.	Wgt. of bread Lbs.	Time	Power used	Cost per lb.
Gas	6,400	8	58	31 ft.	0.232c.
Electricity .	6,137	9	52	0.92 units	0.142c.

The figure for the cost of electricity as given in Table I., is the average of seven tests taken over a lengthened period. The figure for gas is the average of four tests.

The tests were started at an average of 380 degrees Fahrenheit and finished at an average of 350 degrees Fahrenheit. The heating up from cold is not included, as for such a short cooking period the energy required to heat up is an abnormal percentage of the total and gives an incorrect idea regarding the true practical energy consumption on oven work.

It will be seen that the electrically cooked bread takes a shorter period to cook than that done in the gas stove. This is due to the more uniform heat in the electric oven, and hence the door not having to be opened so often. The cooking in the gas oven in these tests was not of a satisfactory nature.

With small cooking vessels gas is cheaper than electricity at the prices named, but with ovens there is a great advantage in electricity. The total amount of energy taken by the small pots and pans in working practice is only a small proportion of the energy taken in oven work, varying from twenty-five to thirty-five per cent, so that in general practice there is little reason to doubt that for overall economy electricity can and does compete with gas in price if suitable apparatus is forthcoming.

Utility of Appliances.—The chief rivalry is at present going on between what are called the "hot-plate" system and the "self-contained" system, both of which have advantages in different directions.

In the hot-plate system one or more single or variable-speed hot plates are used in connection with ordinary cooking vessels, care being taken that the bottom of the vessels are as flat as it is possible to get them. The hot plates, not having to be moved, can be connected to the circuit by metal-sheathed wire and efficiently grounded and there is no risk of shock to the operator. The cost of the hot-plate system is less than the self-contained one, and the simplicity of operation is much improved. The principal objection is the low efficiency and the question as to whether this low efficiency is a serious disadvantage or not depends entirely on the price per unit paid by the consumer.

In the self-contained system each vessel has its own electrical heating gear, generally with three or four different heats controlled on the series-parallel system by means of three plugs and contact pins. No attempt is yet made by most makers to ground the appliances. When this is done an additional flexible wire is required to be run from the vessel to the main earthing-point, making three wires per vessel as a minimum.

The great advantage of the self-contained system is in respect to its high efficiency; the higher the price of power is, the more necessary it is to adopt this system. The reliability of the electrical part of the vessels has much improved lately, and there is little risk of burning these out, except through excessive carelessness.

The materials employed and the difficulty of efficient cleaning in vessels made by some makers is not above criticism. Owing to a complaint by a consumer, the author recently examined a series of vessels marketed by a manufacturer in which the electrical parts were excellent. The vessels, however, were constructed with a brass bottom and copper sides, the brass being soldered to the copper. The vessels were lightly silver plated, which plating all worked off after one or two scourings. A sharp right-angle bend between the sides and the bottom added to the difficulty of cleaning. Metallic poisoning is the inevitable result of such construction.

Solid-pressed aluminum appears to be a good all-round metal if kept thoroughly clean, its only disadvantages being that it does not attain such a bright lustre as copper or brass. Cast aluminium is objectionable, as it is liable to be porous, and hence dirt lodges in the pores.

The most important piece of cooking apparatus in general use and the one which is most difficult to make satisfactory in operation is the cooking oven. The great bulk of the work is done in this and it has to be capable of turning out good material. Some makers follow the lines of the gas ranges and endeavor to combine the oven with hot plates or similar arrangements. Others make the oven an entirely separate piece of apparatus, and this arrangement appears to give the most satisfaction in practice, except where space is extremely limited. The essentials of a satisfactory oven are: (1) Rapidity of heating up to cooking temperature; (2) good arrangements for heat conservation; (3) reliable and simple electrical parts; (4) cooking operations to be better and more easily carried out than in either coal or gas ovens.

The average temperature of oven cooking is about 350 degrees Fahrenheit, varying from 250 to 400 for various applications. To be of real service this temperature of 350 degrees should be attained from cold, say 60 degrees Fahrenheit, in about fifteen minutes. This high speed of heating up is not only a convenience but also an economy as the "idle period" radiation losses are reduced thereby. A fifteen-minutes' heating speed involves a somewhat heavy demand on the supply mains, thus an oven of a cubical contents of 3.55 feet requires three kilowatts as a minimum, and this will be exceeded if it is not efficiently constructed.

The heat energy applied inside an oven is utilized in three ways: (a) In converting the crude food into the finished article; (b) loss due to radiation; (c) loss due to hot air escaping principally experienced when the door is opened.

The last may and generally does form by far the biggest percentage loss, and if the oven can be arranged so that the door is practically never opened except when the food is taken in or out great economy in heat energy is effected.

The author has spent some little time in working out this problem, and there appears to be very little doubt that the whole secret of success depends on two things: viz., uniform heat throughout the cooking area, and a steady movement of the hot-air cur-

rents in the correct directions, to avoid "airlocks" over and around the food. If these two factors are in operation the cooking is perfectly uniform throughout the oven, the food does not require to be moved periodically, and hence the oven door does not need to be opened unduly. If the door is not to be opened for inspection it is, of course, essential that there be a light inside and an inspection window. A thermometer is also a practical necessity, as with a well lagged oven it is impossible to estimate the temperature inside from feeling any external part.

To attain a practically uniform heat round all parts of the food, particularly in big sizes of ovens, presents some difficulties. The arrangement eventually adopted by the writer was to generate the heat at the bottom, deliver it then into vertical "flues," the flues passing it into the oven proper at the top. The hot air is then forced from the top by fresh hot air continually rising in the flues—through all the area containing food—to the bottom where it again comes in contact with the heating elements and the process then repeats itself.

With regard to retaining the heat in the general body of the oven, the general practice is now to have the oven double-jacketed with the hollow walls filled with dry air retained in a cellular state by means of finely divided asbestos or slag wool. Both of these materials give excellent results if the jacket is made one and one-half inches to two inches thick.

The electrical part has in the past been one of the weakest details in oven work. The style of heating-element employed, provided it is of sound construction and long life, is not of much importance; no particular alloy of metals can have a better efficiency than any other alloy, and the element is only a means of converting a definite quantity of electrical energy into a fixed amount of heat energy. The connections of the elements to the switchgear and the design of the switchgear itself is, however, of considerable importance.

The switchgear itself should be simple and unbreakable. The use of tumbler swiches, although the cheapest arrangement, is to be deprecated, as with the heavy currents required they may burn out very quickly in unskilled hands. A small controller operated by one handle appears to give the best results, and only two heating speeds —"fast" and "slow", and "off"—are really necessary.

A requirement in vessels used for boiling is what is known as "simmering." It is only by chance that a series-parallel control supplies exactly the right amount of heat for this operation, and an attendant has consequently to stand over the work and ring the changes on the plugs, with consequent loss of time and an unsatisfactory result.

The writer has recently been testing a new hot plate by a firm in which the soundness of construction probably surpasses any other he has examined. Unfortunately it is made for one heat only, which renders it practically useless for general cooking work.

A hot plate with a graded regulator to turn its power down from full to one-tenth full (say eighty watts) would be a very valuable piece of cooking apparatus.

Cost of Appliances.—The high cost of good electrical cooking appliances is a source of complaint in many quarters. We must recognize, however, in considering this, that the output is yet extremely limited and general design not firmly established; hence manufacture on factory lines with large outputs is not being undertaken. Reliability has been attained and design is rapidly improving. Large outputs only are now required to reduce prices very considerably. Probably a co-operative scheme amongst supply authorities, in which a large quantity of one standard article was to be ordered at one time, would be the best means of rapidly reducing prices to a popular level.

Cost of Electrical Energy.—The price per unit at which power can be obtained for domestic uses will ultimately be the most important factor. Two public authorities already supply at one cent per unit. A considerable number charge two cents, and the range of prices in the future is likely to generally be between these two figures.

Free Current for Slogan Sign.

In connection with the decision of the city of Pasco (Wash.) to install a slogan sign reading, "Keep Your Eye on Pasco," the Pacific Power & Light Company has agreed to furnish the necessary electrical energy to operate the sign free of cost.

An Enviable Six-Day New-Business Record.

As announced in these columns September 2, 1911, H. M. Byllesby & Company of Chicago, took over the management of the Sioux Falls Electric Light & Power Company, and the Sioux Falls Light & Power Company, thereby relieving a situation which seriously threatened the welfare of the public-utility business in Sioux Falls, S. D., owing to the competition which existed between these two companies.

During the first six days that the consolidated company operated, an enviable new-business record was made. Contracts were signed for wiring seventy residences and ten commercial institutions for lighting service. Four power installations were made aggregating twenty-two horsepower in motors. One forty-one lamp sign was contracted for and eighty-three electric flat irons placed in service.

When it is considered that Sioux Falls is a town comprising only 15,000 inhabitants this record speaks well for the ability of J. F. McGuire, new business manager.

Encouraging Electric Power on the Farm.

Ontario farmers are to be shown the latest development in the use of electricity. Adam Beck has made arrangements for the purchase of a number of electrical devices which he and Chief Engineer Sothman, of the Hydro-Electric Commission, saw in everyday use in Germany during their recent investigations in that country . The farmers with small motors pumped all the water used, cut the wood, milked the cows, sowed the seed and threshed the grain. This machinery will probably be installed at the Ontario Agricultural College,

Brooklyn Edison Company Secures Large Contracts.

The sales department of the Edison Electric Illuminating Company of Brooklyn has just closed a contract with the Tidewater Paper Mills, covering the complete power equipment for a paper making plant. The Tidewater Company will be located in South Brooklyn and will use approximately 1,000 horsepower in electric motors. The contract is made for a long term, and the estimated revenue will be approximately $75,000 per year.

Industrial Power

ELECTRIC FURNACE TREATMENT OF NICKEL ORE.[1]

SOME RESULTS OF COMMERCIAL TESTS.

BY WALTER LEONARD MORRISON.

The nickel deposits of the Consolidated Nickel Company are located about one-half mile from Webster, county seat of Jackson County, North Carolina. It is about three miles from Dillsboro, a station on the Murphy branch of the Southern Railroad, which is 48.9 miles from Asheville, N. C. The property is divided into a northern and southern half by the Tuckaseigee River. The altitude of this property is about 2,000 to 2,300 feet above sea level. The property can be reached by dirt roads from Dillsboro which parallel the Tuckaseigee River. The property is such that it can be worked the year around.

The nickel deposits are associated with the Peridotites of the Southeastern Appalachians and run approximately north and south for a distance of over 7,000 feet and nearly 1,500 feet wide. The north end of the deposit immediately adjoins to the east the town of Webster. The ore is very closely allied to the Garnierite of New Caledonia. It is a hydrous silicate of magnesium and nickel, but variable in composition as regards the mutual displacement of nickel and magnesium. It is amorphous, filling certain cracks with incrustations of delicate, hemispherical, or stalactitic forms, usually soft and friable, falling to pieces in water, unctuous to the touch, and adhering slightly to the tongue. It varies in color from brown through pale yellowish green, to a deep apple green. The depth of color usually accompanies an increase of the nickel contents. These seams or veinlets are from one inch to eighteen inches in thickness, and are very numerous and traverse the rock in a manner similar to the veins of the human body.

The electric smelter and equipment is located on the nickel deposit at its middle point. It is about 400 feet from the river and on an elevation forty feet above the river at low-water mark. The buildings are located on a gently sloping hill.

The general buildings consist of a boiler room, engine and dynamo room, furnace room, concentrating room, and storage bins for ore, coke and limestone. The ore bins were only put in temporarily, as the plant was started before it was completed. It was originally intended to have a dryer for the ore, so as to utilize the heat of the escaping gases, but it was not installed for these first tests.

In the boiler room there are four horizontal-fired tube boilers of 200 horsepower each. The fire boxes are of the dutch-oven type, designed to burn wood. However, wood was not easily obtained in the vicinity, so coal had to be burned. Draft is furnished by a ninety-foot stack, six feet in diameter. Feed water is introduced into the boilers by means of injectors, a reciprocating steam pump being on hand in case of emergencies. Bituminous coal is fired in the boilers, this being obtained from Virginia and Tennessee. A ten-inch steam main delivers the steam to the engine.

The steam engine is of the Hamilton Corliss type, single-acting, with twenty-four-inch cylinder and six-foot stroke. Working steam pressure is 115 pounds. The flywheel is twenty-four feet in diameter, with a six-foot face. The line shaft is driven from the flywheel by a six-foot, three-ply leather belt. The line shaft drives two direct-current generators, which furnish the electric power. Provision is also made for the installation of a third generator.

The two generators are each driven from the line shaft by a thirty-six-inch, three-ply leather belt. Each generator is of the duplex compound-wound type, with a capacity of 170 kilowatts. The voltage is 50, amperes 3,500. The two machines are connected in parallel, with an equalizer between. Each machine has eight poles and 112 brushes.

At the switchboard circuit-breakers are installed to protect the machines against an overload. When starting the dynamos a bank resistance is used on the line, so as to get the machines working with constant voltage; after each machine is working with approximately the same voltage, they are thrown in parallel, and the line resistance cut off as soon as the load from the furnace comes on.

There are eight 1,000,000 circular-mil copper cables on each leg carrying the current between the generator switchboard and the furnace-room switchboard. These cables are carried through a concrete conduit below the floor level. Each switchboard is equipped with circuit-breakers, ammeter and voltmeter. The furnace is connected to the switchboard by eight 500,000 circular-mil copper leads to each leg.

In the concentrating room two full-size tables were set, but they were not used, as the metal separated from the slag very nicely. The furnace-room equipment consists of the furnace and electrode-control, switchboard, four slag pots (500 pounds capacity), and weighing scales for ore and flux. Under the sheds near the ore bins there was a twelve-horsepower steam engine, belt-connected to a Sturtevant crusher, for crushing coke, limestone and ore.

The furnace used in Webster is similar to the one which was used at Sault Ste. Marie by Dr. P. L. T. Heroult, with a few modifications. The furnace was originally designed in two sections, it being intended that the top section could be removed in order to patch up the crucible, but later this was found to be unnecessary.

The bottom plate of the furnace is of cast iron 1.5 inches in thickness, set on porcelain blocks for insulation. Tapered holes were bored in the cast-iron plate, and iron rods 10 inches long by 0.5 inch diameter were inserted, in order to give a large area of contact. A large copper plate was fastened to the cast iron at the rear, to which the lugs carrying the cables were secured. The furnace shell is made up of 0.625-inch iron plate.

1 Abstract of a paper presented at the Twentieth General Meeting of the American Electrochemical Society in Toronto, September 21-23.

The shell of the furnace was insulated from the cast-iron bottom with heavy asbestos and fiber bushings around the bolts. The interior of the shell was first lined with 0.25-inch asbestos. A mixture of hot graphite and glucose was tamped into the bottom of the furnace around the iron pegs. Above the pegs the amount of graphite was lessened, and coke dust substituted, and near the top of the bed coke dust with a binder was used. The coke lining was carried up the side for a distance of ten inches; this coke lining appears to resist the corrosive action of the slags better than any other material used. The cover of the furnace consisted of fire brick clamped together by tie rods.

The lining of the furnace required about four days, one man and helper. The graphite and glucose were heated in an iron soap kettle. Materials used in the lining and cover of the furnace were as follows: One barrel glucose, three-fourths of a ton of coke, 2,000 fire bricks, one barrel sand, one ton graphite, 1,000 circular fire bricks, two barrels fire clay and twenty sheets asbestos.

After the lining was all in a wood fire was built in the furnace and kept burning three days. This dried the furnace very well. After this the electrict current was run in the furnace for several hours, which finished the drying out of the bottom of the furnace.

The furnace was started with a little coke in the bottom, but after a few trials this was found to be an unnecessary precaution. The electrode was controlled by a hand-wheel located on the floor, connected to a worm and gear, on a carriage, by a chain. To the gear on the carriage was secured a notched wheel which carried a chain connected to the electrode holder. The holder is very heavy, being made of cast iron, and weighing about 1,000 pounds. The carbon electrode which was first used weighed about 1,400 pounds when new. During the operation of the furnace, if the current was shut off for more than an hour it would usually cause the furnace to freeze up. At first the coke caused trouble in the furnace, by accumulating, but this was eliminated by using finer coke, and a little less of it. A decrease in the electrode consumption when finer coke was used was also noted.

The electrodes first used were of carbon, built up from smaller electrode sections. The large electrode was eighteen inches square by seven feet long, made from 3 by 6-inch carbon slabs. The first time the electrode was heated by the arc it cracked and pieces broke off in several places. The pieces were picked out of the furnace, and ore with flux fed in, trusting that after a slag bath had been formed the cracking would stop; however, this was not the case; after having to stop frequently to pick out solid pieces of the electrode weighing 25 to 50 pounds, the furnace was shut down, this electrode, after so much damage, being too short for further use. It was removed and the other carbon electrode placed in the holder.

Before striking an arc with the second carbon electrode a wood fire was placed beneath it in order to heat it up evenly. After two hours of this treatment, the electrode was placed in the furnace, contact made, and ore started in. The electrode, however, went to pieces.

A copper bushing for the holder was then ordered, so that two Acheson graphite electrodes could be used together. The Acceheson electrodes were spliced so as to feed continually without waste. These electrodes held up finely and gave very good results. The dynamos gave trouble, however, and we could only draw half load; consequently, for nearly all the runs only one eight-inch Acheson graphite electrode was used, which carried as high as 5,000 amperes at times.

The dynamos are of the duplex, compound-wound type, made for this special work, but gave considerable trouble from sparking at the commutator brushes.

The ore as it comes from the mine contains 40 to 50 per cent water, as moisture. On this account a dryer of old steel plates was rigged up and the ore partially dried in the sheds, using wood as a fuel. The mining was done by open cut work. A small tram-road from one of the old cuts near the smelter to the ore shed was built. The ore was hauled in a one-ton car, by a horse, from the cut to the ore bins. Ore from some of the other cuts was also used, this being brought in on ox carts. The higher grades of ore were picked, but for the bulk of the runs the ore as it came from the mine was used. On a large scale an aerial tramway would be the ideal way of handling the ore, as the deposit is located on a small hill, and deep mining would not have to be resorted to for a long time. For the soft ores a steam shovel could be used. The hard ores are not difficult to break up, for they are easily drilled.

The efficiency of the present furnace under the present conditions is not very high. The efficiency of this furnace as compared with one utilizing the waste gases to preheat and dry the ore is estimated at 60 to 70 per cent. The fact that wet ore instead of dry ore was used makes a difference of 6 to 8 per cent in the efficiency.

No. 1	No. 2
4 tons brown ore.	3 tons brown ore.
1.02 tons limestone.	0.6 tons limestone.
0.48 tons coke	0.48 tons coke.
Moisture in ore	42.50 per cent
Total dry ore treated	8,050 pounds
Net time of smelting	45.75 hours
Limestone used	3,600 pounds
Coke used	1,940 pounds
Power used, average kilowatts	170
Kilowatt-hours used	7,755
Kilowatt-years used	0.896
Ore treated per kilowatt-year	9,000 pounds
Ore treated per kilowatt-day	24.7 pounds
Nickel silicide obtained	1,242 pounds
Percent of nickel in alloy	11.90
Silicide obtained per kilowatt-year	1,380 pounds
Silicide obtained per kilowatt-day	3.8 pounds

In other runs, from 8,250 pounds to 10,160 pounds of ore were treated, and from 975 pounds to 2,230 pounds of nickel silicide obtained per kilowatt-year of electric energy consumed. The power consumption is nearly constant per unit weight of ore treated, independent of its metal contents, showing that the chief worth of the furnace is the drying of the ore and the smelting of the slag. The silicide produced contained 10.50 to 22.60 per cent of nickel.

The cost of production varies with the nickel content of the ore and of the silicide formed. The cost of smelting by hydroelectric power is only about fourteen per cent of what steam power costs. The above figures are quite conservative in the case of the hydroelectric power.

The cost of operation is based on the approximate cost, as the plant was operated from October, 1909, to April, 1910, and goes to show the expense of operating or trying to operate in a primitive country. Two shifts of 11 and 13 hours, respectively, were run. The furnace operated about 4 to 5 days out of every week, very little repair work being necessary. The engine gave considerable trouble and during every run several stops were necessary for adjustment of the crankpin or the valves. The generators giving the trouble they did, and

forcing the plant to operate at fifty per cent of full load, caused a great decrease in the efficiency of the power plant. The cost of smelting cannot, therefore, be reasonably figured from the cost of operation which is given herewith:

1 Superintendent	$ 10.00
1 Assistant	2.50
2 Oilers at $1.80	3.60
2 Firemen at $2.40	4.80
2 Assistant Firemen at $1.80	3.60
2 Head Furnacemen at $2.50	5.00
4 Assistant Furnacemen at $1.80	7.20
2 Miners at $1.50	3.00
1 Blacksmith	2.00
1 Timekeeper	2.00
Coal, 18 tons, at $4.50	81.00
Machine oil	4.00
Electrodes	9.10
Flux and coke	3.00
	$148.80

The average power at the switchboard was 200 kilowatts, and there was smelted on an average 7,800 pounds of ore per twenty-four hours.

The cost of power was $0.74 per kilowatt-day, and $270 per kilowatt-year. The cost of power under full load would, therefore, be $0.562 per kilowatt-day, or $206 per kilowatt-year.

In the above figures no account is taken of depreciation, interest, and repairs, which would undoubtedly raise the above figures 10 per cent.

The output of the plant was limited to the available output of the generators, and varied from 800 to 1,200 pounds of silicide per day. This output on the present plant could be raised to 2,500 pounds of nickel silicide, by operating the generators at full load and using a dryer and preheater with the furnace. However, the furnace has served its purpose for a commercial demonstration, and has given the operators a chance for observations which are only possible with one of this kind.

German Electrification.

The German line from Lauban to Konigszelt, and its four branches, are to be electrified at once. The main line and branches all have steep inclines, as they are in the district of the Riesengebirge. Some of the grades on the main line are one in fifty, and on the branches they are one in forty in several instances. It is not proposed to erect a special station for supplying these lines with power, but to purchase current from an existing power station which has undertaken to provide it. One reason for doing this is to ascertain which is the cheaper way of getting power for working electric trains, for the railway to have its own electric works or to buy current from an independent concern.

Electric Cutting Machines for Cement Limestone.

The electrically operated cutter noted in Fig. 1 is working in cement limestone in the mine of the Alma Cement Company and it is stated that for efficiency in operation, ease of control and portability of the apparatus the electric power-driven machines operate most advantageously.

FIG. 1.—ELECTRICALLY OPERATED CEMENT CUTTER.

For mining coal similar machines are utilized as seen in Fig. 2 this being an electrically driven cutter in the mine of the Penn Gas Coal Company. In some cases where there is great danger of gassy mines, electric coal cutters are equipped with flame and gas-proof motors, the starting box and terminals also being designed with gas and flame-proof features for safety.

In the design and construction of electric coal-cutting machines all parts are made interchangeable to insure quick repair, as the machines are required to withstand very rough work and abuse indicent to mine service.

The cutter chains must be of great strength in order to withstand sudden and excessive strains and the wearing parts must be proportioned to insure the longest life possible while the electric equipments are required to have ample power to withstand the most severe work with great overload capacity.

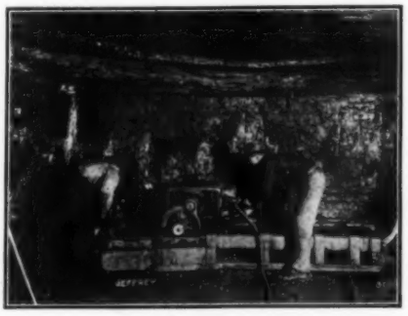


FIG. 2.—ELECTRICALLY OPERATED COAL CUTTER.

The openings in the chain links are arranged at such angles that either chisel or straight pick-pointed bits or combinations of both may be used depending on the character of the cutting.

As the depth of the under cut should always approximate the thickness of the vein the lengths of the cutter frames are usually 5, 6 and 7 feet while the width of the cutter head for breast machine is generally about forty-four inches. In some instances a thirty-nine inch cutter head is utilized where the cutting is hard or when for any other reason a narrow head is preferable. With these electric coal cutters the speeds of the feed and pull back can be varied to obtain the largest output consistent with the hardness of the cutting.

Coal Consumption of London Railways.

An official return gives the following details regarding the cost of coal and mileage run on some of the electric railways of London for the half year ending June 30 last as compared with the corresponding period of 1910.

Railway.	Cost of Coal. 1911.	Cost of Coal. 1910.	Miles Run. 1911.	Miles Run. 1910.
Metropolitan	$140,500	$124,800	2,069,097	1,958,884
District	107,000	95,500	1,576,978	1,497,613
Central London	23,800	26,500	860,877	920,091
City and So. London	25,000	21,200	719,556	710,568

Effect of Ammonia on Nickel-plating Solutions.

The presence of ammonia in nickel solution should always be avoided, for it makes the nickel deposit dark in color resembling iron, hard and brittle and lacking the tenacity and toughness of that formed in a neutral or slightly acid solution, and apt to peel. If a large amount of ammonia is present the deposit frequently flakes off in the solution, particularly if a high current density is employed.—*Brass World.*

Railway Electrification in Australia.

The Royal Commission on Melbourne traffic in the city of Melbourne, Australia, has issued a report in favor of the electrification of the suburban railways and tramways. This will involve an expenditure exceeding $25,000,000.

Electric Power for Coke Ovens.

The largest coke oven in the world is being built at Gary, Ind., for the Indiana Steel Company. Electricity furnishes all the power for powdering the coke, blowing the fire, handling the coal and drawing the charged ovens.

Telephony · Telegraphy and Wireless

Wireless in Morocco.

Some wireless military installations are already in operation in Morocco. A singing-arc station of five kilowatts is established at Tauorirt and communicates, with a wave length of three-quarters mile, with Oran, Tangier, Casablanca and Marseilles. The support of the antenna consists of two artillery observation ladders which have been heightened for the purpose from 75 to 100 feet. There are also two portable stations in Morocco mounted on light two-wheeled vehicles. Each unit consists of two or three vehicles. If there are three vehicles one is used for carrying the motor and its accessories, one carries the transmitting and receiving instruments, while the third carries the mast wires. If there are only two vehicles the second carries the mast and the instruments. The mast is sixty feet high when unfolded and is made of steel tubes. Each unit is under a sergeant with five men. The power is sufficient with waves a quarter mile long to secure a range of from sixty to ninety miles. At Casablanca, on the coast about 200 miles north of Agadir, there are four portable stations.—*Electrical Engineer.*

Telephones in Gas Works.

The Association of German Gas and Water Works has sent an inquiry sheet to its members and to the postal authorities in order to ascertain whether any accidents had been caused by the installation of telephones and electric bells in their apparatus rooms. No case of gas being lighted by sparks from those instruments was reported; in special experiments ignition sometimes, but rarely, resulted when gas was blown on the instruments in action. The association hence resolved to permit the installation of telephones in apparatus rooms of gas works; the telephones should, however, be fixed outside, and the bells, if inside, be provided with guards of gauze.

A telephone cable with Pupin coils has been laid between St. Margaret's Bay, England, and La Paune, Belgium.

School of Telegraphy.

A school of telegraphy soon will be opened in a government building in Calle de Chiquis, Mexico City, Mex., which shall have for its aim not only the teaching of telegraphy, but also of electrical science, the construction of apparatus, and many other useful branches which will give the students a diversity of knowledge, so that they will not be confined to the telegraph operator's desk, according to the Minister of Communications and Public Works, who has been studying the subject for some time.

A correspondence school will be maintained, so that students all over Mexico can have the benefit of this new institution. Ingeniero Carlos Islas Bustamante has been appointed superintendent of the school and he is securing competent professors in the various departments preparatory to opening the school at an early date.

Infection From Telephones.

Recently the health officer of Montreal issued a warning as to the dangers of infection from the mouthpieces of telephone instruments. The telephone company wrote a letter to the council declaring that no such dangers exist. In the letter extracts from the works of medical writers are given to show that the dangers of infection are not to be feared.

A Powerful Wireless Station.

Plans have been formulated for the erection of a wireless station of sufficient power to allow steamers plying between Europe and America to keep in constant and direct communication with land at all times during their passage. William Marconi, who has the project in hand, has been conducting experiments at St. John's, New Foundland for some time.

The erection of the station will, it is expected, be begun in a few weeks, and its completion will make St. John's the main distributing point for wireless messages between England and America.

Reinforced-Concrete Telegraph Poles for Pennsylvania Railroad.

To avoid interruptions by severe storms or fires from meadow grass, as well as for durability and appearance, the Pennsylvania Railroad Company has constructed a reinforced-concrete pole line designed to carry sixty aerial wires and two one and one-half-inch diameter lead-incased cables for its telegraph and telephone circuits on the north side of its tracks, across the five-mile stretch of swampy meadow land between Manhattan Transfer and the portal of the tunnels leading into the new passenger station in New York City.

A special yard was established near the line for making and seasoning the poles, which were turned out at the rate of about six a day. A total of 202 poles was required. They are from thirty-five to sixty-five feet long, and rise from twenty-five to fifty feet above the ground. They rest on specially constructed foundations.

On the south side of the tracks fifty-foot steel poles are used to carry the wires for the transmission of traction energy from the Harrison substation to the tunnel portal. They are designed for not only the present needs, but to carry seven additional transmission circuits which may be required in the future. They are supported by concrete foundations on top of groups of piles. Crossing the Hackensack River involved the construction of two high steel towers 181 feet four inches above high water. The wire span over the river is 765 feet long.

Telephone Expansion in Berlin.

Telephonic communication throughout Berlin, Germany, has so rapidly increased that the installation of 1907 has proved totally inadequate. The lines then established have been doubled and fresh installations are still being made. It is expected that at the end of the present year Berlin will possess 200,000 telephone connections. There were already 183,545 at the end of June, an increase of 19,059 having been made since January 1.

BOOK REVIEWS.

"Ventilation of Electrical Machinery." By W. H. F. Murdoch. New York: The Macmillan Company. Cloth, 79 pages (5 by 7 inches), illustrated. Supplied by the ELECTRICAL REVIEW PUBLISHING COMPANY for $1.

This work is intended as an introduction to the problem of ventilation as applied to electrical machinery. At present the cost of electric generators is high, partly on account of the fact that only a small temperature rise is permissible. There seems, however, to be little reason to doubt that, with the advanced technical applications and artificial local cooling, the cost of large generators may be considerably reduced. In this book, indirectly, the question of efficiency is raised through the use of cooling devices, and this is fully discussed. Methods of measuring the "ventilating effect" of armatures are indicated in the chapter on "Ventilating Action of Armatures." Other subjects treated include natural cooling, the ventilating action of fans, the refrigerator as a cooling agent, and practical methods of ventilating motors, etc. A compilation of useful data for thermal calculations is also a noteworthy feature.

"Mechanical Engineering." By Chas. M. Sames. Jersey City: C. M. Sames. Flexible leather, 218 pages (4 by 6½ inches), illustrated. Supplied by the ELECTRICAL REVIEW PUBLISHING COMPANY for $2.00.

This is the fourth edition of this work and it has been considerably revised and enlarged. It is a compact and up-to-date digest of mechanical-engineering science, embracing a wide range of subject matter. It contains a comprehensive collection of formulas, data and constants relating to the proportioning of machine parts, assembled machines and motors, and on this account should prove of value to designing engineers. Some recent subjects and the inclusion of the latest obtainable data on over 100 others make the book as recent as is possible. Its weight and thickness are such that it may be carried in the pocket without inconvenience. The index contains somewhat over 900 items.

"Three-Phase Transmission." By William Brew. New York: D. Van Nostrand Company. Cloth. 178 pages (8½ by 5 inches), illustrated. Supplied by the ELECTRICAL REVIEW PUBLISHING COMPANY for $2.00.

This is a practical treatise on the economic conditions governing transmission of electrical energy by underground and overhead conductors. The author has endeavored in this work to cover two important phases of the subject. First, to bring prominently before the reader such economical and financial points as engineers and specialists engaged upon new work would find useful, and, in the second place, to provide the student with concrete examples of problems which, while demanding scientific treatment, will not depend upon commercial considerations for their useful solution. With this in view, mathematics have been omitted from the text as far as possible, and where algebraic expressions are introduced these are of an elementary character. References have for the most part been omitted and the book contains considerable original investigation and data. Throughout the text the all-important question of "Will It Pay?" has been taken into consideration. Among the general subjects discussed are transmission losses, working pressure, control, impedance, harmonics, etc., grounding and line appliances.

"Electroplating." By Henry C. Reetz, Chicago: Popular Mechanics Company. Cloth, 99 pages (4½ by 6½ inches), illustrated. Supplied by the ELECTRICAL REVIEW PUBLISHING COMPANY. for $0.25.

This is a handbook on electroplating which gives brief and practical directions for those interested and engaged in the business, with no more technical detail than is necessary for practical work and yet with such explicit directions concerning the actual operations as is necessary and useful to the beginner. A valuable feature is the diagrams and drawings showing the various apparatus used, how it can be made and how it should be applied.

"Testing Electromagnetic Machinery." By Bernard V. Swenson, Budd Frankenfield and John M. Bryant. New York: Macmillan Company. Cloth, 324 pages (5½ by 8½ inches), illustrated. Supplied by the ELECTRICAL REVIEW PUBLISHING COMPANY for $2.60.

This is Volume II of a series dealing with testing of electromagnetic machinery and other apparatus and considers alternating current, Volume I having treated of direct-current machines and apparatus. The text comprises a series of experiments conducted in various electrical engineering courses, each experiment being self-contained. In each case a number of references is furnished for the purpose of more thoroughly familiarizing the student with the subject under consideration before performing the experiment and to assist in the preparation of a written report. Considerable space is devoted to theory and method; the observations required are specified under "data," and each experiment, of which there are 127, is concluded with a number of questions bearing directly upon the subject. In the arrangement of the experiments a rough classification has been made and certain groups of experiments have been provided with short introductions to give the student a general idea of the methods used by the authors in dealing with that particular group.

"Straight Line Engineering Diagrams." By Manifold & Poole. San Francisco: The Technical Publishing Company. Leather, pocket size. Supplied by the ELECTRICAL REVIEW PUBLISHING COMPANY for $3.00.

This book is of pocket size and contains a series of over forty diagrams by the use of which one can determine, without knowledge of mathematics, without the use of a handbook, slide rule or table of logarithms, approximate computations which field engineers and others who have neither time nor information available for careful calculation often have to arrive at. The book is provided with a piece of clear celluloid on which is scribed a straight line. This is called the index and will be found convenient in the solution of problems. The diagrams are all solved, in a similar manner, as follows: From a known point on any scale a line is carried to a known point on another scale, and where it cuts the remaining scales which are to be read simultaneously, as shown by arrow points, solutions are found. Beginning with the design of foundations, arches and reinforced concrete walls, the strength and dimensions of all necessary material can be readily determined. Stadia readings can be quickly reduced, the capacity of pipes and flumes easily found, the economic size of pipe selected and the weight of material for wood-stave or steel pipe lines determined. Where steam is to be used, the horsepower of different-sized engines can be mechanically determined and the power transmitted by shafting, gearing and belting calculated. Electric wiring problems and those of pole-line construction are worked simply and the comparative cost of power easily shown. Many other electrical problems are treated.

FINANCIAL REPORTS OF ELECTRICAL COMPANIES.

AMERICAN LIGHT & TRACTION.

The report of the American Light & Traction Company for the month of August and eight months ended August 31, compares as follows:

	1911.	1910.
August gross	$ 284,127	$ 267,302
Expenses	9,194	11,516
August net	274,933	255,786
Eight months gross	2,579,331	2,318,057
Expenses	74,777	79,862
Eight months net	2,504,554	2,238,195

KINGS COUNTY ELECTRIC.

The report of the Kings County Electric Light & Power Company for the month of August and eight months ended August 31 compares as follows:

	1911.	1910.
August gross	$ 365,171	$ 344,963
Expenses	186,711	169,997
August net	178,460	174,967
Charges, depreciation, etc.	118,247	107,349
August surplus	60,213	67,618
Eight months gross	3,065,717	2,793,614
Expenses	1,537,592	1,337,874
Eight months net	1,528,124	1,455,740
Charges, depreciation, etc.	907,422	824,499
Eight months' surplus	620,702	671,241

NORTHWESTERN ELEVATED.

The Northwestern Elevated Railroad Company has issued its report for the year ended June 30, 1911. The income account compares as follows:

	1911.	1910.
Gross	$2,731,375	$2,632,039
Expenses	1,084,804	1,055,686
Net	1,646,571	1,576,353
Charges, taxes, etc.	1,209,062	1,200,254
Surplus	437,509	376,098
Preferred dividends	200,000	150,000
Surplus	237,509	226,096
Earnings on $5,000,000 preferred stock	8.7%	7.5%

EDISON COMPANY OF BOSTON.

The annual report of the Edison Electric Illuminating Company of Boston for the year ended June 30, 1911, compares as follows:

	1911	1910
Gross	$5,257,913	$4.709,456
Expenses	2,796,803	2,688,720
Net	2,461,110	2.020,736
Miscellaneous Inc.		81,202
Total Inc.	2,461,110	2,101,938
Charges	189,993	253,288
Balance	2,271,117	1,848,650
Dividends	1,867,035	1,555,596
Surplus	404,082	293,054

During the past fiscal year the company sold 88,402,626 kilowatt hours of electricity. The number of customers using commercial incandescent lights increased from 32,142 to 36,633, while customers using commercial arc lights decreased from 1.111 to 1,078. Average number of employes for year was 1,188, against 1,160 in 1910. The company used 124,724 tons of soft coal, against 111,136 in 1910; average cost in 1911 was $3.85 per ton and in 1910, $3.47.

LONDON UNDERGROUND.

The Underground Electric Railways Company of London, Ltd., has issued its report for the six months ended June 30, 1911. The income account compares as follows:

	1911	1910
Income from investments, operation of power house, int., etc.	£158,536	£147,614
Gen'l expenses, salaries, interest on bonds, etc.	119,039	121,221
Balance	39,497	26,393
Interest on income bonds plus taxes	39,250	26,077
Surplus	247	315

BOSTON & WORCESTER.

The report of Boston & Worcester Street Railway Company (the operating company) for fiscal year ended June 30, compares as follows:

	1911	1910
Gross earnings	$615,686	$570,145
Expenses	355,855	333,312
Net	259,831	236,833
Interest and Taxes	165,364	176,123
Balance	94,466	60,709
Dividends	.....	30,375
Surplus	94,466	30,334

WESTERN UNION TELEGRAPH COMPANY.

The following statement exhibits the condition of the Western Union Telegraph Company at the close of the quarter ended June 30, 1911:

Surplus March 31, 1911, as per last quarterly report		$9,313,702.36
Net revenues, quarter ended June 30, 1911		1,982,493.17
		$11,296,195.53
From which appropriating for:		
Dividend of three-fourths of one per cent, paid July 15, 1911	$747,886.50	
Interest on bonded debt	433,953.05	
		1,181,839.55
Left surplus June 30, 1911		$10,114,355.98

The following statement exhibits the estimated condition of the company at the close of the quarter ending September 30, 1911:

Surplus June 30, 1911, as above		$10,114,355.98
The net revenues of the quarter ending September 30, based upon completed returns for July, partial returns for August and estimating the business for September, will be about	$2,220,200.00	
Less interest on bonded debt	434,062.00	
Leaves estimated net earning for the quarter, less interest on bonded debt		1,786,138.00
		$11,900,493.98
It requires for a dividend of three-fourths of one per cent. on capital stock issued about		747,887.00
Deducting which, leaves a surplus, after paying dividend, of		$11,152,606.98

DETROIT UNITED RAILWAY.

The report of the Detroit United Railway Company for the month of July and seven months ended July 31 compares as follows:

	1911	1910
July gross	$959,588	$938,599
Expenses	616,283	586,726
July net	343,304	351,873
Other income	14,490	12,680
Total income	357,794	364,553
Charges and Taxes	177,377	180,797
July surplus	180,417	183,756
Seven months' gross	5,727,637	5,282,666
Expenses	3,642,573	3,357,511
Seven months' net	2,085,063	1,925,155
Other income	99,941	86,748
Total income	2,185.004	2,011.904
Charges and taxes	1,234,654	1,153,854
Seven months' surplus	950,350	858,050

AMONG THE CONTRACTORS AND SUPPLY MEN

C. H. BAUMGARTEN, Freeport, Ill., has been awarded the contract for wiring a club house which is to be erected by the Freeport Country Club.

GRAMBS & PEET, Bismarck, N. D., were awarded the contract for installing 128 ornamental light posts for lighting the city of Bismarck. The contract price was $12,157.

THE JAHANT ELECTRIC COMPANY, Cleveland, O., will install the electrical work in the Library Building which is to be built at Cuyahoga Falls, O. The architects are Bridges & Nelson of Cleveland.

THE SCHUYLKILL ELECTRIC CONSTRUCTION & SUPPLY COMPANY, Pottsville, Pa., was awarded the contract, by the Citizens' National Bank, for installing chandeliers in the bank building.

THE VAN WAGONER CONSTRUCTION COMPANY, New York City, has the contract for installing conduit and wiring in the new Postoffice Building in New York. The contract price was $55,720.

THE E. A. KELSEY ELECTRIC COMPANY, Crawfordsville, Ind., has opened an electrical supply store in that city. The company will actively enter the contracting field, and will devote especial attention to wiring, etc.

THE SOUTHWESTERN ELECTRICAL COMPANY, Riverside, Cal., has been awarded the contract for the installation of an ornamental street-lighting system on Twelfth Street of that city. The contract price was $2,395.

THE DAUN & CRAWFORD ELECTRIC COMPANY, of 407 Ames Street, Saginaw, Mich., has been awarded the contracts for wiring the new Y. M. C. A. Building and for installing the electrical equipment of the new Duryea Automobile Works at Saginaw. The company is also re-wiring the works of the Michigan Sugar Company at Carrollton, near Saginaw.

Increase in Ohio's Coal Output.

Ohio's total production of coal in 1910 was 34,209,668 short tons, with a spot value of $35,932,288, according to Edward W. Parker, of the United States Geological Survey.

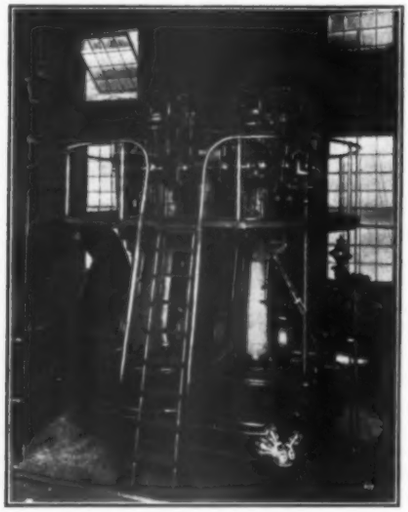
New Electrical and Mechanical Apparatus and Appliances

The Atlas Crude-Oil Engine.

A four-cycle engine into which you simply feed air, compress it to 500 pounds per square inch, resulting in a temperature of approximately 1,000 degrees Fahrenheit; a fuel pump spraying small quantities of crude oil into the air chamber; a complete burning of this fuel through the heat generated by the high compression of the air—is the principle of the Atlas (Diesel type) oil engine.

The Atlas oil engine is of the vertical, single-acting, inclosed type. These basic features contribute to compactness, low mechanical losses accompanied by long-lived cylinders, pistons and packing rings, convenient removal of pistons, steady operation at all speeds, automatic lubrication, protection of working parts and small expense for upkeep and attendance.

The base under each series of cylinders is a separate casting of the deep-box type, heavy, massive, amply reinforced and with liberal surface in



ATLAS ENGINE ASSEMBLED.

contact with the foundation. It contains the housings for the main shaft bearings and is carried well up around the cranks, the crank case thus forming a suitable reservoir for lubricating oil.

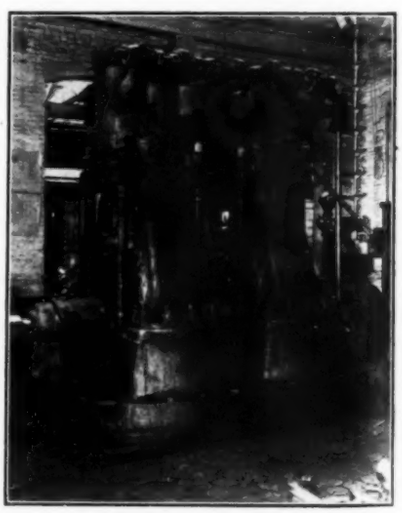
The "A" frame over each crank is cast in one piece with the cylinder and water jacket. It is of majestic proportions, tough, fibrous iron being used unsparingly, but with a view to scientific distribution. It fits tightly on the base, completely covering the crank pit, the upper end being arranged for rigid

SINGLE CASTING FOR ATLAS ENGINE.

attachment of the cylinder head. The gradual change from rectangular section at the bottom to round section at the top is pleasing to the eye. The lines are strong, as well as symmetrical. The stresses in the cylinder are transmitted in straight lines to the base through four heavy steel rods running directly from the bottom of each cylinder to four heavily reinforced anchoring places below the shaft bearings. These rods are of sufficient strength to carry the maximum stresses due to compression and ignition, and relieve the "A" frame of any liability to fracture from these causes. Removable oil shields fitted to the side openings of each frame complete the inclosure of the reciprocating parts and afford easy access for inspection or adjustment of the crank and wrist-pin boxes without affecting the oil-tightness of the joints.

The main bearings are in halves, split horizontally. They are lined throughout their length and circumference with anti-friction metal of suitable composition, firmly hammered into anchoring recesses, grooved for proper distribution of lubricant, bored and scraped to secure perfect contact with the shaft. Each bearing is fitted with two ring oilers running in a removable saddle or reservoir box filled with the splash from the crank case. After removing the babbitted cap which forms the upper half of the bearing, the lower sleeve or box which rests in the saddle can be rolled out around the shaft for inspection. The saddle or reservoir box is an independent casting supported by a substantial wedge controlled by heavy screws extending through the engine base, by means of which, without reaching or getting into the crank case, any desired adjustment of the main shaft can be made from the outside. The main shaft is a solid forging of open-hearth steel. The crank throws are fitted with fan-tail counterweights which absorb vibration. The connecting rods are of the usual heavy round section, forged from open-hearth steel. The lower ends are of the marine type, the upper ends being solid.

The liner which constitutes the wall of each cylinder is cast separately from the cylinder proper. By this method the most suitable mixture for each is possible. The main bodies of the cylinders call for a tough fibrous



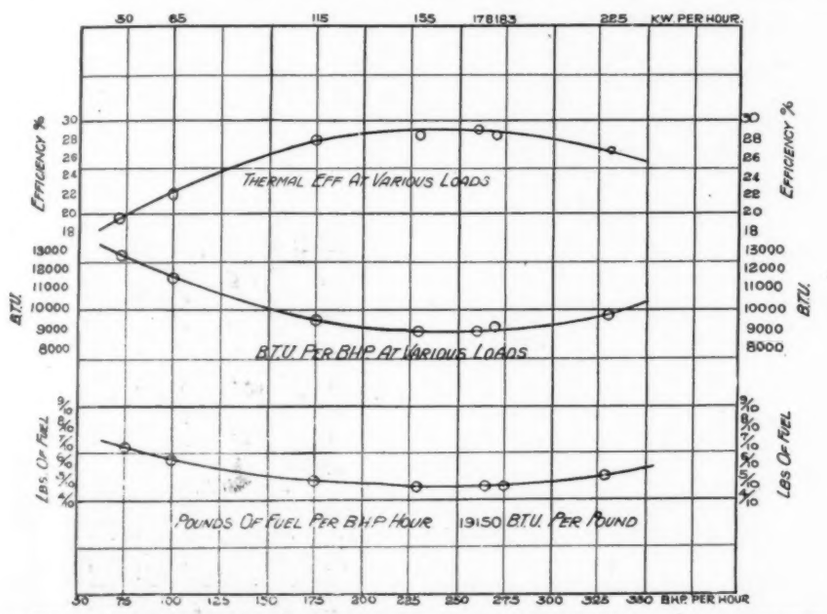
ATLAS ENGINE PARTLY ASSEMBLED.

iron, while the liners are poured from fine-grained charcoal iron as hard as it is practicable to machine since they must be impervious to high pressure in order not to lose compression through seepage and must also withstand the alternate expansion and contraction due to the difference between the suc-

tion charge of atmosphere and the temperature during the combustion period. Care has been exercised to provide for unimpeded circulation of the cooling water and the jackets are of ample cross-sectional area at all points. Suitable provision is made for inspection and cleaning.

The cylinder heads are of the same hard, close-grained iron as the cylinder liners and are water jacketed. They are unusually deep and the metal has been distributed in such a manner as to insure long life, notwithstanding the expansion and contraction to which they are subject. A metal to metal joint is made between each cylinder and its head, at the inner end of the cylinder the wear is on the rings rather than on the bore. A hardened-steel wrist pin is ground to a perfect surface and firmly secured in the piston. When the upper and lower quarters wear sufficiently to warrant it, the pin can be turned around ninety degrees to present new surfaces for wear.

The splash system of lubrication is used, because it is the most effective and at the same time the cleanest. The fan-tail cranks at each revolution dip into the lubricating oil in the crank cases and splash it to the walls of the cylinders, the crank and wrist pins and the main shaft bearings. Pockets or funnels assist in catching the oil and conveying it to the crank and wrist



EFFICIENCY AND FUEL-CONSUMPTION CURVES OF A 300-HORSEPOWER ATLAS CRUDE-OIL ENGINE.

latter, instead of at the outside flange. All valves (admission, exhaust, fuel, starting and relief) are attached to the cylinder heads, and need not be disturbed when the heads are taken off. Each relief valve is so situated that its removal, which is readily accomplished, affords access to the entire combustion chamber for purposes of inspection, without lifting off the cylinder head.

The pistons are of the long-trunk type, slightly tapered at the upper ends to neutralize expansion. They are as light as the duty permits, and being made of hard iron of close texture, there is little or no wear. Each piston is fitted with seven snap rings. The tension on these rings is comparatively slight and as they are of somewhat softer iron than the walls of the pins. The frames, cylinders and crank cases are tightly inclosed, but large openings in the sides of the frames, covered by removable plate shields, give convenient access to all interior surfaces beneath the piston.

In a report of a test of an Atlas oil engine by C. E. Sargent, consulting engineer, Chicago, the following expression of approval was written by Mr. Sargent:

"Conforming to your request for my opinion on the design of the Atlas oil engine recently tested at your works, I wish to state the general design is in harmony with the most successful vertical engines extant. While the construction is massive and the parts of great strength, they are not too heavy for the pressures carried, and the proportions are so symmetrical that the whole presents a very attractive appearance. I particularly commend the design for the distribution of metal around the center line of crank shaft and cylinders, the tie rods for carrying the stresses and strains to the base, the shape of the cylinder head with its ribless construction and location of valves, providing almost an ideal combustion chamber, and the independent cylinder liner.

"The fuel valves work efficiently and correctly at all loads. The governor shows regulation not surpassed by the best Corliss engines. The accessibility of the transmitting parts, with resulting ease of inspection and attendance, together with their liberal proportions and the thorough means you have provided for lubricating these parts, make the engine thoroughly dependable for continuous service.

"You are to be complimented on these details of design, which in my opinion will contribute to reliable and efficient operation with minimum attention and consequent low maintenance cost."

The accompanying table is a summary of tests of a 300-horsepower Atlas oil engine, and the accompanying curve shows the efficiency and fuel consumption as per these tests.

Date of run	6-21-11	6-20-11	6-20-11	6-19-11	6-21-11	6-20-11	6-21-11
Duration of test in hours	1.	1.5	3.	2.	2.5	4.	1.
Load in K. W. hours by switch board meter	67.	83.3	132.	173.5	200.4	205.75	249.
K. W. to compressor by Watt meter	24.75	22.66	23.6	25.5	29.6	29.25	31.
Transmission losses to compressor 23.6 per cent	5.84	5.34	5.5	6.	6.98	6.91	7.31
Net K. W. used by compressor	18.91	17.32	18.1	19.5	22.62	22.35	23.69
B. H. P. used by compressor	25.32	23.20	24.25	26.13	30.31	29.94	31.74
Net K. W. delivered to line	48.09	65.98	113.9	154.	177.78	183.4	225.31
Net E. H. P.	64.44	88.41	152.62	206.36	238.22	245.75	301.91
Generator efficiency, per cent	87.	88.	89.	90.	91.	91.3	91.
Manufacturers' rating	74.	100.4	171.4	229.2	261.7	269.4	331.7
Net B. H. P.	174.7	174.1	173.13	173.1	172.9	171.9	171.
Rev. of engine, per minute	50.	61.3	81.	108.	120.4	128.	167.
Fuel oil used, lbs. per hour	1.04	.92	.71	.7	.68	.7	.74
Pounds oil per K. W. hour	14.22	12.73	9.73	9.6	9.27	9.55	10.15
Gal. oil per 100 K. W. hours	.67	.61	.472	.47	.46	.476	.503
Pounds of oil per B. H. hour	9.18	8.36	6.47	6.44	6.3	6.51	6.9
Gal. of oil per 100 B. H. P. hours	12829.	11680.	9038.	9000.	8808.	9115.	9632.
B. T. U. per B. T. P. hour $\frac{2545}{\text{B.T.U. per B.H.P.}}$	19.8	21.7	28.15	28.27	28.9	28.	26.4
Fuel Cost of 100 K. W. hrs. in cts. Oil at 2 cents per gallon.	28.44	25.46	19.46	19.2	18.54	19.1	20.3

Motor Control in Mines.

Electric power is especially well adapted to the operation of coal mines and since each mine has its own fuel handy, the utilization of the cheapest form of siftings to produce electricity is an exceedingly economical form of power production. For this reason, with many others, electrical power in coal mines is coming more and more into use every year. One of the most important considerations in connection with electrically operated coal mines is the control of ventilating fans and water pumps, because on these depend, to a great extent, the safety of the miners.

The mine pump must be uninterrupted in its service so as to keep the mine free from water; and the continuous operation of the mine fan is equally important so that the dangerous gases will at all times be driven out and clear air substituted. Statistics show that in the anthracite mines of Pennsylvania during the past twenty-five years, 11,491 deaths have occurred, and about 8 per cent of these deaths were due to explosions. In the bituminous mines of Pennsylvania the number of deaths for the same twenty-five years is 6,366 and about 15 per cent of these deaths were due to explosions. Often the shutting down of one of the large ventilating fans of a mine means temporary shutting down of that particular section of the mine, which depends on the fan for ventilation. Moreover, when this ventilation ceases, the danger of serious explosions occurring is greatly increased. Electrically driven fans are not as expensive as the old type operated by steam engines. The higher speed of rotation of the electric motor permits of using a fan of smaller diameter for the same volume and pressure.

The motor for this work must be well protected by a controller that is unaffected by voltage fluctuations or by the severe atmospheric conditions of a coal mine.

The accompanying illustrations show several of a recently developed line of direct-current controllers made by the Cutler-Hammer Manufacturing Company of Milwaukee for mine work. These controllers are absolutely automatic in their operation, being remotely controlled by small snap switches or automatically, by float switches. After the motor is once started by either of the above methods, it will take care of its own functioning until stopped by a similar snap switch or float-switch scheme, mentioned above. There are no fuses to be replaced and no circuit-breakers to be reset manually and thus much time and expense is saved. Although these safety auxiliaries are omitted the mine starters are so equipped that a failure of voltage will in no way damage the motor, even though no attention is given the starter before the voltage again resumes. The starter is also equipped with a single-coil overload which will trip when an overload occurs, thus inserting all of the armature starting resistance. As soon as the normal conditions again return, the motor will automatically be brought up to speed. Each mine-duty starter has a voltage relay which causes all of the armature starting resistance to be reintroduced in the armature circuit in case there is a bad drop in voltage, or in case of voltage failure. This feature not only protects the motor from "flashing over" between the brushes, which is so apt to occur during wide voltage fluctuations (more or less common in mines) but it insures the motor against any possible injury through excessive current in rush during starting, by causing all of the starting resistance to be inserted before the motor is started. The armature starting resistance is designed for continuous running duty under low-voltage conditions so that there is no danger from "burn outs."

In Fig. 1 is shown a small sliding-contact type starter used for small motors up to fifteen horsepower. The voltage relay is mounted on the upper right corner while the clapper-type main switch is mounted opposite on the left. Fig. 2 is a special type for large motors equipped with automatic means for weakening the shunt field of the motor

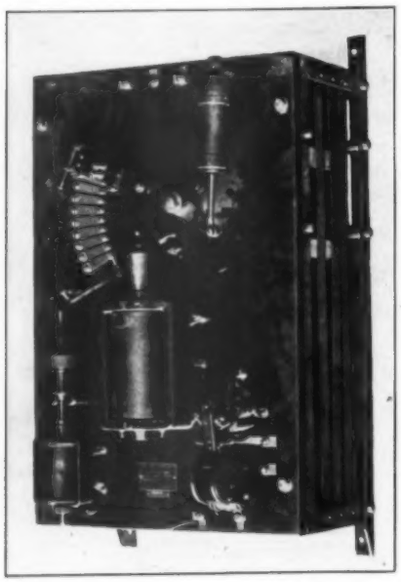


FIG. 1.—SLIDING-CONTACT MOTOR STARTER.

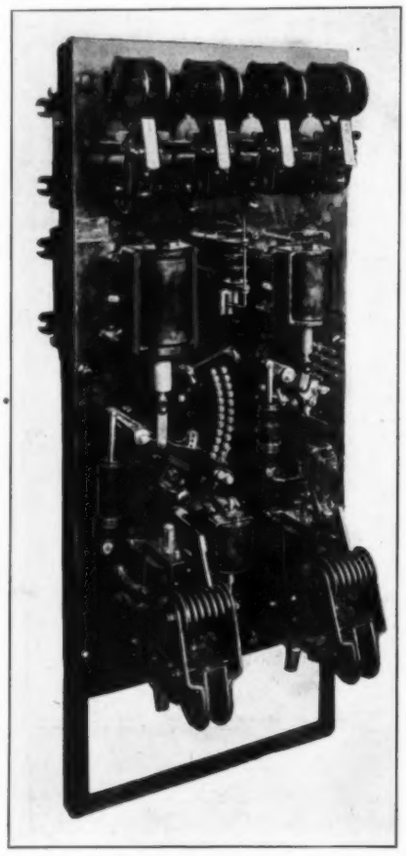


FIG. 2.—SPECIAL PANEL FOR LARGE MOTORS.

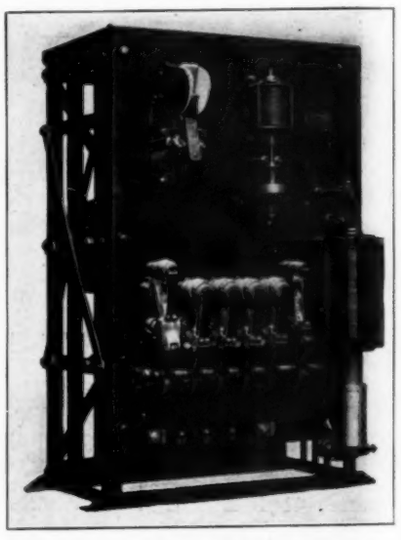


FIG. 3.—SCHUREMAN TYPE OF MOTOR STARTER.

after it comes up to normal speed. Fig. 3, which is a forty-horsepower 220-volt type B starter, has the Schureman type butt-contact, crank-switch acceleration. The large solenoid at the right operates the switches. Standard sizes include controllers for motors up to sixty-horsepower. Panels and resistances of all controllers for mine duty are treated with a moisture-proof compound and all metal parts are made of brass or are copper-plated to minimize deterioration.

Electric Glue Heating Appliances.

It has been authoritatively stated that more than $4,000,000 is paid every year by manufacturers in this country for glue. It has also been asserted, by those in position to know, that approximately one-half of the glue purchased, or $2,000,000 worth, is wasted yearly. Some of this waste is unavoidable, but much of it can be prevented. A great deal of glue is spoiled through overheating. It is well recognized that the proper temperature for melting glue lies somewhere in the neighborhood of 140 degrees Fahrenheit. It is also thoroughly appreciated that, if the temperature of glue is allowed to much exceed 160 degrees Fahrenheit, if it is not rendered wholly unfit for use its strength will be greatly impaired. An expensive glue thus abused will be no more effective than a cheap one.

Either live or exhaust steam has a temperature (at atmospheric pressure) of at least 212 degrees Fahrenheit. This is altogether too high for glue heating.

Electrical methods of glue heating are, when properly applied, ideal. The ease with which the heat can be controlled, the evenness of the temperature afforded, the readiness with which electricity for glue pot or heater operation can be conducted to any part of a factory and its economy are all convincing recommendations for the electrically heated appliances.

The Westinghouse Electric & Manufacturing Company is manufacturing a line of glue-heating appliances that have been designed to incorporate all desirable features. They appeal to practical men because of their simple and common-sense design and the fact that they are very ruggedly built to withstand the abuse of industrial-plant service. While the Westinghouse Company makes portable glue pots in capacities of 0.5 pint, one pint, one quart, two quarts and four quarts, flush bench-type glue pots in capacities of one pint, two quarts and four quarts, and glue cookers in capacities of three gallons, five gallons, ten gallons, fifteen gallons, twenty gallons and twenty-five gallons, it also sells separately the electrical heaters used in the devices, so that any manufacturer can fit his present line of glue heating devices for electrical operation.

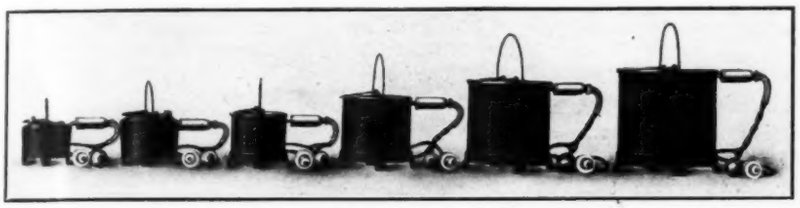


FIG. 1.—PORTABLE ELECTRIC GLUE HEATERS.

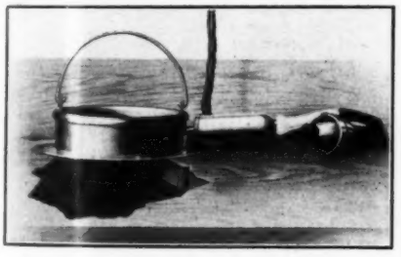


FIG. 2.—FLUSH BENCH-TYPE HEATER.

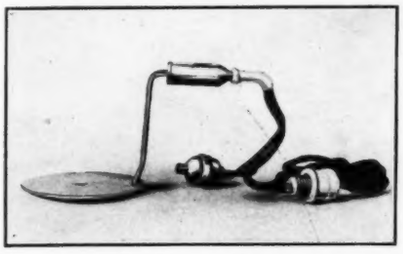


FIG. 3.—DISK IMMERSION-TYPE HEATER.

All the Westinghouse glue-heating devices are equipped with immersion-type heaters—those which are submerged in the liquid to be heated. Obviously, this is the most efficient type of heater for liquids, in that all of the heat developed in the heater must be imparted to the liquid. None can be lost by direct radiation from the heater. Disk-immersion-type heaters, like that shown in Fig. 3, are used in the glue pots while bayonet-type-immersion heaters are used in the glue cookers.

The construction of the portable glue pots is evident from the accompanying illustrations. Although glue pots of cast iron, with tinned-iron glue vessels, can be furnished in capacities of one-half pint and one pint, the regular line has spun-copper glue vessels, it having been found that this is the most satisfactory material for glue receptacles. Substantial bails are provided on both the casings and on the glue vessels. The portable pot is designed for use in any part of a shop where it can be connected to an electric socket. Obviously, this pot can be taken to the work, the heater connected to a nearby socket and the glue can be kept hot while needed.

Flush-bench-type glue pots are designed for mounting in bench tops or slides as shown in Fig. 2. Glue vessels and electric heaters are interchangeable between portable and flush-type glue pots of equal capacities.

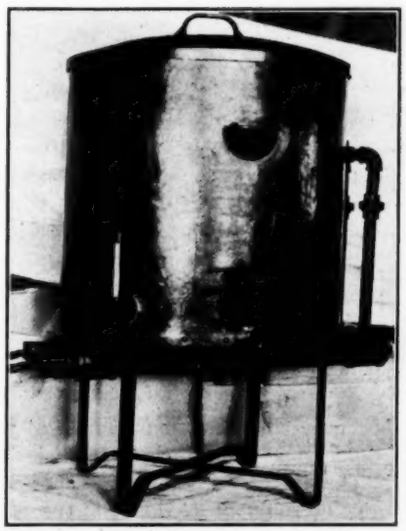


FIG. 4.—ELECTRIC GLUE COOKER.

The Westinghouse glue cooker (Fig. 4) is built just as substantially as it is possible to build a device of this type. The glue and water vessels and the cover are of heavy copper and will last indefinitely. The bayonet-type heater is located in a vaporizing chamber located under the water vessel. Almost immediately after current is turned on, water is evaporated and the vapor rising through the circulating pipe enters the space surrounding the glue vessel. Because of this arrangement of the vaporizing equipment, the space is filled with vapor in a very short time—long before the entire body of water is heated to the vaporizing temperature.

New Office Building for the New York & Ohio Company.

A commodious brick building has been erected on Dana Avenue, Warren, Ohio, in which the sales department of the New York & Ohio Company, manufacturers of Packard incandescent lamps, will soon be located. The completion of this modern, splendidly equipped structure for the accommodation of the company's office is the latest outward manifestation of a history of growth extending over the past twenty-five years.

In 1885 the Packard Electric Company, which was organized by the Packard brothers of Warren, began manufacturing incandescent lamps in a small way, in addition to their other lines of electrical products. Five years later the lamp business had increased to such an extent that a separate company was organized to handle it; and the new firm was called the "New York & Ohio Company," for no more weighty reason than that one of its members came from New York State and another from Ohio. Three years after its organization, or in 1893, the young company had grown to such dimensions that a special building, separate from the factory, was constructed for its sales department. In 1902 the New York & Ohio Company became a member of the National Electric Lamp Association and its engineering work has ever since been carried on at the engineering laboratories of the latter, in Cleveland, but the main office and sales department of the company have remained at the same location in Warren, near the lamp works. During the past few years the demand for Packard lamps has been increasing, making it necessary, on account of the expansion of the office work, to transfer some of the departments to the less-crowded neighboring factory building. A time was fast approaching, however, when on account of growth it would no longer be possible to resort to this method of providing increased room, and accordingly a new building has been erected which should provide adequate housing for the company's offices for several years to come.

The New York & Ohio Company will be thoroughly domiciled in its new quarters before October first, with every facility for accommodating visiting customers and for handling the executive and clerical details of a large selling organization.

New Industrial Lighting Equipment.

While the past types of Holophane-D'Olier steel reflectors did much towards solving the industrial-lighting problem by providing units of extremely high efficiency and wide applicability, there are certain conditions where those reflectors with their aluminum

NEW HOLOPHANE STEEL REFLECTOR.

finish are unsuitable on account of deterioration due to acid fumes or excessive dirt or exposure.

It was with a view to meeting adverse conditions that the Holophane Company perfected a new line of steel reflectors having a tough enamel finish and with the holders and connections of copper.

These new reflectors here illustrated are finished both inside and out with a white enamel, which is claimed to have a reflecting value about eighteen per cent higher than any other at present available. This enamel is not affected by chemical fumes or by weather conditions and is very easily cleaned, which

ENAMELED REFLECTOR.

means that there is no corroding or other deterioration. They are furnished in the extensive type only.

Three holding devices are now available for use with Holophane-D'Olier reflectors. The clip-spring holder is well-known, being the type that has hitherto been supplied exclusively; a new 2.25-inch heel which admits using the steel reflectors with standard holders, and a porcelain socket holder which allows the use of steel reflectors in many installations where brass sockets are not permissible, are now supplied also.

Telephone Train Dispatching.

The Great Northern Railway, which already has nearly 4,000 miles of track equipped with telephone train dispatching equipment, has just placed an order with the Western Electric Company for thirty-two telephone selectors to equip its Cascade division in the State of Washington.

The circuit will be divided into two sections. The first will extend from Tye to Everett Junction, with a branch from Monroe to Tolt, and another from Pacific Avenue to Delta. The second section will run from Tye to Leavenworth. The distance covered by the first section will be 93 miles, while that covered by the second will be 36 miles. The dispatcher for both circuits will be located at Tye.

The Pennsylvania Railroad Company has also recently ordered fourteen Western Electric selectors for use in its Hudson tunnels. The section equipped is known as the Jersey City-Newark division, and it is nine miles in length. The dispatcher will be located at what is known as the "S C" tower, and No. 16 B. & S. copper line wire will be used. The standard 50-A Western Electric selectors will be installed, and, in addition to this, fourteen special six-line test boards have been ordered. There will also be thirteen ten-line jack boxes, which will be used for blocking purposes.

The Toledo & Ohio Central, which about a month ago adopted the telephone for dispatching trains on its eastern division, has recently placed another order with the Western Electric Company for thirty-one telephone selectors for its western division.

This new circuit will extend from Columbus, where the dispatcher will be located, through to the Union Station at Toledo, a distance of 132 miles. When both circuits are completed the Toledo & Ohio Central will be operating 280 miles of track by the telephone.

Wireless in Portugal.

The Portugese Government has notified the British and Italian Governments that it has decided to adopt the Marconi system of wireless telegraphy. Stations are to be erected at Lisbon and the principal points along the coast and at Cape Verde. It is understood that Portugal has been accorded the same terms as accepted by the British Government.

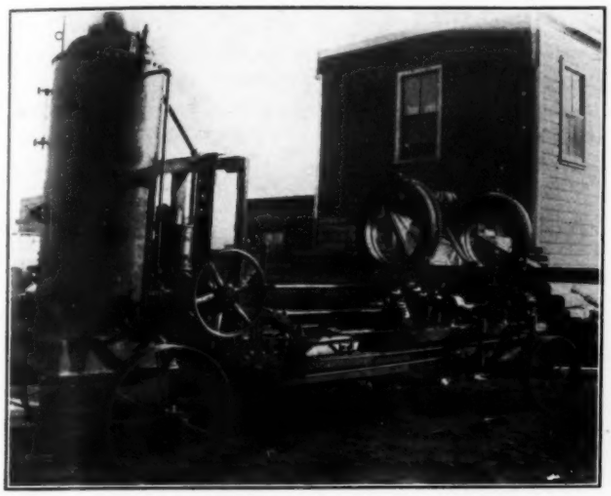
The B. & E. Pole-Preserving Machine.

The steadily increasing cost of pole timbers, due to the gradually diminishing supply, has caused all companies using wood poles for overhead circuits of any kind to consider methods for increasing the life of these poles. Many preservative treatments have been proposed and tried out to a limited extent. On the one hand is the high cost of an effective pressure treatment of the entire pole and on the other hand the inefficacy of brush or non-pressure treatments.

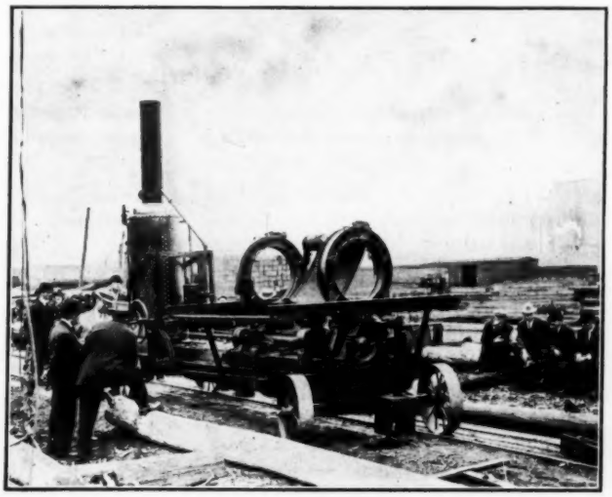
Careful observation has shown that poles decay almost exclusively at the ground line, where the zone of prolonged exposure to both moisture and air forms a fertile breeding place for insects that destroy the wood cells. It seems logical, therefore, that the portion of the pole near the ground line needs the chief protection. The problem of providing a simple and inexpensive method of applying such a treatment engaged the attention of George P. Benton and I. B. Eberhardt, experienced cedar-pole men, who after several years of investigation and experimental work conceived what is known as the "B. & E. pole-preserving machine"

A demonstration of this machine was made on September 20 in the pole yard of one of the largest public-utility corporations of Chicago. About a dozen representatives were present from the United States Forest Service, and from several of the leading electric-utility companies of Chicago and other cities. Three thirty-five-foot Michigan cedar poles cut last winter were treated seven, ten and fifteen minutes, respectively, with heated creosote oil which was injected by an air pressure of about five pounds per square inch into a three-foot band corresponding to the ground belt of the pole. With the ten-minute treatment an initial penetration of three-sixteenths inch was obtained and this extended in a few days to a depth of over one-half inch. The pole in the ten-minute treatment absorbed a full gallon of oil in the three-foot band that was subjected to the treatment. These tests clearly showed the simplicity and value of the process.

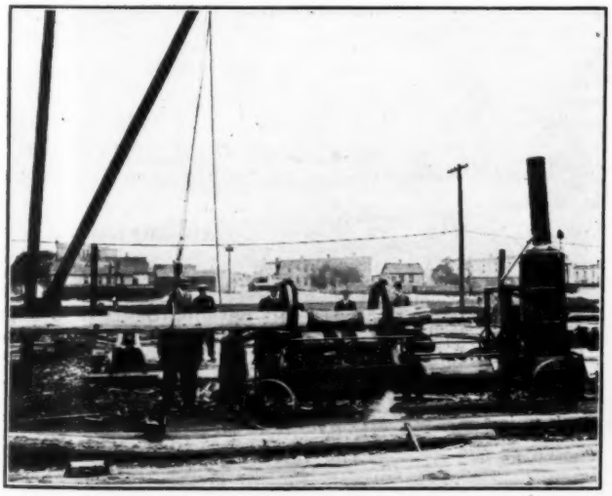
A fair idea of the machine may be obtained from the accompanying illustrations, which are from photographs taken during the tests just referred to. The machine is about nineteen feet long and six feet wide, and is mounted on iron wheels so that it may be easily hauled about by a team of horses to



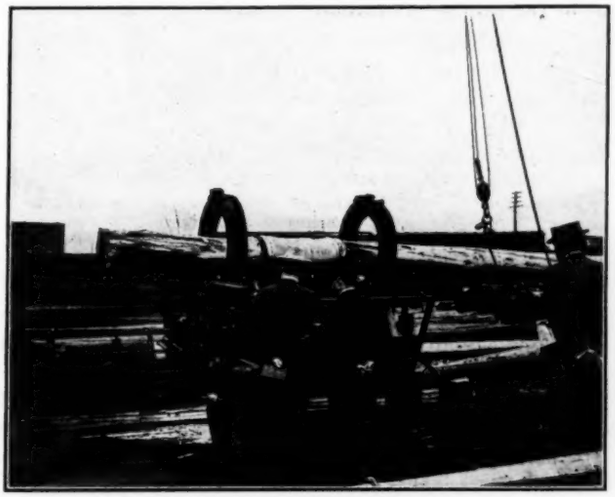
THE B & E POLE-PRESERVING MACHINE.



ANOTHER VIEW.



POLE READY FOR TREATMENT.



THE ACTUAL TREATMENT UNDER PRESSURE.

various positions in the pole yard or taken from yard to yard. The main parts of the machine are: a steam boiler, an air compressor and storage tank, a closed oil tank containing steam coils for heating the preserving oil, an air-tight canvas band, three feet wide, which encases the pole at the zone to be treated, and the necessary gearing and mechanism to pass this band about the pole and tighten it. If a large number of poles are to be treated, a platform is built on either side of the machine or the latter is placed in a trench so as to have the iron skids level with the ground; a simpler plan is to place inclined skids on each side of the machine.

The operation of the machine is quite simple. The pole is rolled onto the iron skids. The two segmental rings known as track rings, are closed about the pole by turning a hand wheel. The spool carrying the canvas band is then revolved about by an opposite movement of the hand wheel. A clamping bar is wedged against the band so that the latter forms a closed bag or cylinder around the pole. Air pressure is applied to the edges of the band to tighten it and then the compressed air is allowed to enter above the oil in the tank, thus forcing the heated oil through a pipe connection into the bag and entirely around the pole for any desired length of time. Any oil oozing out of the bag, as for instance through checks in the pole, drops into a basin on top of the tank, into which it is later drained by opening a drip valve. Thus no oil is wasted by spilling on the ground nor by treating more than that part of the pole that is subject to decay while in service. By means of the reverse operations the pole is released and then rolled off the other side of the machine, the entire operation taking only a few minutes beyond that required for actually subjecting the pole to the oil.

Any kind of coal-tar oil may be used. The capacity of the machine is about fifty poles per day. Poles from seven to twenty-four inches in diameter may be handled. The cost of treating each pole, which includes labor, oil, fuel and fixed charges on the machine, is only a fraction of a dollar for a seven-inch top thirty-five-foot pole.

This process of pole preservation and the machine for carrying it out are fully protected by basic patents. The machine is manufactured by the B. & E. Pole-Preserving Machine Company, Fisher Building, Chicago. This company is now also in position to furnish poles, treated according to the above method, from Chicago.

A New Inter-Phone Set for Selective Ringing.

The Western Electric Company recently placed on the market a new line of inter-phones which will fill a long-felt want in residences, factories, schools and mercantile establishments where intercommunication between stations is not so frequent as to require separate lines.

These sets are arranged for selective ringing, common-talking service, that is, any station may call any other station without interfering with any of the others. These sets are designed for

EIGHT-BUTTON INTER-PHONE SET.

use where conversation between two parties at one time is all that is required. They will give just as satisfactory service as the individual-line type gives on large twenty-four-line systems, where often two or more conversations are necessary at the same time. They are made in capacities of four and eight buttons.

The accompanying illustration shows the eight-button set, known as the No. 1327-L. This is a non-flush wall set, but a desk type is also furnished when desired. The standard finish for the 1327-L type sets is oak, but other wood finishes can be supplied to order. The instrument, though compact, is not crowded, and the apparatus is arranged so as to make installation easy, as only one set of batteries is required for the whole system.

Some Electrical Properties of Monel-Metal Wire.

The new alloy, Monel metal, is now being made in the form of wire at a cost that permits of favorable comparison with high-grade German silver, although the properties of this new wire are of such high order that is should not be confused with numerous white metals of German or nickel-silver. Tests have shown this new wire to be as strong as steel wire, while it is less corrodible than copper.

The electrical tests have shown Monel-metal wire to have the following properties: electrical resistivity, 256 ohms per mil-foot (temperature coefficient, 0.0011 per degree Fahrenheit); electrical conductivity, four per cent, with copper taken as 100 per cent.

This wire will doubtless find a large sale for use in places where German silver has heretofore had the preference, as, in addition to its electrical advantages, it possesses the other remarkable qualities mentioned above.

Wireless in Egypt.

As a result of negotiations which have been conducted for some time past, the Egyptian Government has granted a concession for the monopoly of wireless telegraphy in Egypt and a very powerful station will be erected at Port Said. At present there is a small installation at Aden, mainly for communicating with Berbera in British Somaliland, and there are stations with moderately strong equipments at Port Said and Suez. These stations will be superseded by the new installation, by means of which it will be possible to send messages westwards probably as far as Malta in the Mediterranean and eastwards down the Red Sea to Aden. The station will be ready to receive messages from warships of all nationalities. It is hoped that the new station will be in working order in October.

Convention of Byllesby Employees.

The third annual convention of the Association of H. M. Byllesby & Company will be held in Chicago, January 2 to 5 inclusive. Pres. T. K. Jackson, of Mobile, is at present working on the program of papers and predicts that the coming convention will surpass any of those previously held, both in point of attendance and papers. R. E. Flower, of the Mobile Electric Company, Mobile, Ala., is the secretary.

Current Electrical News

COMMISSION NEWS FROM NEW YORK.

(Special Correspondence.)

The Public Service Commission, Second District, on Monday held a hearing at Albany, taking up the complaint of Mayor Charles C. Duryee, of Schenectady, who asked that the Commission order the Schenectady Railway Company to restore its rate of twenty-five cents for six passenger tickets good for rides within the city limits of Schenectady. In the year 1909 this company discontinued the sale of this reduced form of transportation. In his complaint Mayor Duryee alleged that the company has obtained many franchises from the city upon the understanding that the rate of twenty-five cents for six tickets would be continued. Three previous complaints on this rate have been filed with the Commission, but it held that it was without jurisdiction to act upon them. Under an amendment passed by the Legislature of this year the Commission is vested with power to determine complaints of this character.

From residents of Ulster Park, Ulster County, and members of Ulster Grange No. 969, the Public Service Commission has received a complaint requesting the issuance of an order directing the New York Telephone Company to render direct service from Ulster Park with the Kingston exchange without toll charge. At the present time the telephone company has established a boundary between Kingston and Esopus with the exchange centering at Esopus, and including Ulster Park and vicinity. The subscribers from this exchange have to pay a toll rate for Kingston calls, or are charged for mileage at the rate of $8.00 per mile for direct communication with the Kingston exchange. Complainants state that even after paying this mileage charge they are still required to pay toll to talk with subscribers on the Esopus exchange. It is claimed that the boundary as determined by the telephone company is arbitrary and made without due respect to the needs and convenience of residents of this section. This complaint has been served upon the company and an answer will be filed within twenty days.

The Public Service Commission, Second District, has authorized the Empire Gas & Electric Company to issue $51,000 in five-per-cent joint first and refunding thirty-year gold bonds. The bonds are to be sold at not less than eighty-five and the proceeds used in extension and improvements to the company's property in Auburn, and other proper capital expenses of the company.

The Public Service Commission, Second District, has received a preamble and resolution from the Common Council of the city of Watervliet reciting that that city, with a population of 15,000, has no telegraph office; that the Western Union Telegraph Company has received a valuable franchise from the community permitting the erection of poles and wires for the conduct of its business, and for many years did maintain and conduct an office in that community, but for some reason, discontinued the maintenance of such office. The Commission is asked to compel the Western Union Telegraph Company to establish, and maintain a centrally located office for the sending and receiving of messages in the city of Watervliet. The complaint has been served upon the company and an answer required within twenty days.

LIGHTING AND POWER.

(Special Correspondence.)

MAYNARD, MINN.—The Council has been petitioned to install an electric light plant. C.

VIRGINIA, MINN.—The Council has been petitioned to acquire the electric light plant. C.

DEEP RIVER, IOWA.—Bonds for the installation of an electric light system have been voted. C.

MORRIS, MINN.—The Morris Electric Light Company is planning to install its wires in conduits. C.

COLFAX, IOWA.—The Colfax Electric Light Company will furnish light and power to Prairie City.

DEVILS LAKE, N. D.—Petitions are being circulated for the installation of a curb lighting system. C.

AITKIN, MINN.—M. D. Stoner has applied for a franchise to supply the village with electric light. C.

SHERIDAN, MONT.—The Madison Power Company will extend its line down the Rubt Valley this fall. C.

CORYDON, IOWA.—This town is to at once begin the reconstruction of its electric lighting system.

SUTTER CREEK, CAL.—The Poundstone mine is planning to install new electric pumping machinery. A.

SPOKANE, WASH.—The Washington Water Power Company is planning to install a system for distribution to the mining properties in the Cœur d'Alene district, Idaho. A.

KANSAS CITY, KAN.—The American Electric Company has been incorporated with a capital of $2,500.

RUNGE, TEX.—Local citizens are promoting the installation here of an electric light and power plant. D.

FAIRVIEW, S. D.—The Sioux Valley Power Company will call for bids for the construction of a power plant. C.

DAVIS, CAL.—The Pacific Gas & Electric Company is planning to rebuild and improve its substation at Davis. A.

MORRIS, MINN.—The Council is considering the installation of cluster lights, at an estimated cost of $3,000. C.

GOLDFIELD, NEV.—The Vernal mines, Diamondfield, contemplate the installation of new electrical equipment. A.

BENKELMAN, NEB.—The Rock Creek Power & Light Company has been incorporated with a capital stock of $25,000.

DECATUR, TEX.—The Decatur Water & Light Company will rebuild its electric light plant which was recently burned.

REDFIELD, IOWA.—Bonds for $15,000 for the establishment of an electric light and water works plant have been voted. C.

MORTON, WASH.—A. W. Van Arsdale has been granted a franchise for an electric light and water system at Morton. A.

BRAHAM, MINN.—The Eastern Minnesota Power Company, of Pine City, Minn., will construct an electric light line to this city. C.

FOLSOM, CAL.—The Pacific Gas & Electric Company will build a power line from Folsom to Roseville in the near future.

LAKE CITY, MINN.—The Minnesota & Wisconsin Power Company has broken ground for a high-tension transmission line to Red Wing. C.

SIOUX FALLS, S. D.—Business men are planning a double row of cluster lights on Main Avenue, from Eighth to Tenth Streets. C.

COLUMBUS JUNCTION, IOWA.—R. D. Parks, engineer, Lake Crystal, Minn., proposes to install an electric light plant, at a cost of $15,000. C.

ROCHESTER, MINN.—The contract for cluster lights on streets tributary to Broadway was let to the Hartig & Company, Minneapolis. C.

WEAVERVILLE, CAL.—The Trinity Dredging Company has been granted a franchise for a power line along the county roads near Lewiston.

LOGAN, UTAH.—The Agricultural College of Utah has taken bids for the erection of a hydroelectric power plant at Logan. J. W. Jensen is engineer. A.

WEISER, IDA.—Stuart M. French, Engineer, is at the head of a project to install electric pumping plants on the Snake River and in western Oregon. A.

SAN BERNARDINO, CAL.—The City Council has granted to Fred. B. Mechlin a franchise for an electric lighting and heating system in that city.

ELK CITY, IDAHO.—The Welch Tunnel Gold Mining Company plans for the erection of an electric power plant. R. K. Welch is head of this company. A.

THIEF RIVER FALLS, Minn.—Bonds for $40,000 for the installation of a steam power plant as an auxiliary to the electric light plant, have been voted. C.

WHITLOCK, CAL.—It is reported that A. H. Ward, San Francisco, is planning for the erection of a hydroelectric power plant in the Sweetwater district. A.

LOON LAKE, WASH.—Gerhke & Sons, operating a lumber mill here, are at the head of an enterprise to install an electric-lighting plant to serve this district. A.

OLYMPIA, WASH.—The Twisp Valley Power & Irrigation Company has been incorporated by Harry Burke and C. F. Lohman, with a capital stock of $20,000.

VACAVILLE, CAL.—The Pacific Portland Cement Company has been granted a franchise for a transmission line along the public highways of Vacaville township.

WHEATLAND, CAL.—The Pacific Gas & Electric Company is building a new power line to the Huntington tract to supply power for pumping and irrigation work. A.

TROY, ALA.—A new power plant is to be built for the Pea River Power Company, which supplies power to Troy, Dothan and several other cities. The plant will be built at a cost of $150,000 and when completed will be in charge of Charles Henderson.

PRINCE ALBERT, SASK.—Residents of the city have agreed to subscribe $775,000 for the construction of a 3,500-horsepower hydro-

electric power plant at Lacolle Falls, Saskatchewan River. Cecil F. Smith will be engineer in charge. A.

ORANGE, N. J.—Improvements are to be made in lighting here, and to this end the present arc lights will be removed and an incandescent lighting system installed.

ESCONDIDO, CAL.—The city has entered into contract with the Escondido Utilities Company for street lighting, with increased lighting facilities, for a period of five years. A.

ALBIA, IOWA.—L. T. Richmond, J. E. Loeb and J. M. Gass are a committee to ascertain the feasibility of securing electric power and light from the big dam at Keokuk. C.

CHEHALIS, WASH.—The Washington-Oregon Corporation will extend its wires to Hoskill to furnish power and light for the rock quarry there, and also to Littell and Adna.

LAPORTE, IND.—A contract has been awarded by the Board of Public Works to the A. M. Osburn Company, of Chicago, for the construction of a new light and waterworks system. S.

LOGAN, UTAH.—The City Council has decided to install a series tungsten system of street lighting. The change from the present system will be made at a cost of about $2,200.

PEARL HARBOR, H. T.—The C. C. Moore Company, San Francisco, Cal., has been awarded a contract at a price of approximately $158,000 for power plant equipment for the naval station here. A.

ASHLAND, WIS.—The Ironwood & Bessemer Railway & Light Company is about to commence the construction of a power line from Mellen Falls, to Ashland, a distance of twenty-seven miles. C.

NEWBURGH, N. Y.—A new lighting system is to be installed in Water and Colden streets of this city. Fifty-three ornamental poles are to be erected. An appropriation of $3,515 has been asked.

SALINAS, CAL.—F. G. Baum, representing the Monterey County Gas & Electric Company, has been awarded the contract for an electric power line along the county roads of the Salinas Valley.

RIVERSIDE, CAL.—The Edison Electric Company has secured a site near Bloomington depot on which a substation will be erected at once to supply that section with electric light, heat and power.

PASADENA, CAL.—W. A. McNally & Company, Pasadena, has been awarded a contract at a price of $34,000 for 161 ornamental light posts, with incandescent lamps, to be erected on South Orange Avenue. A.

SACRAMENTO, CAL.—The West Sacramento Electric Company, recently incorporated, plans for the construction of an electric railway in the Yolo Basin district. H. W. Furlong is interested in this company. A.

CALEXICO, CAL.—The Farmers' and Merchants' Club is interested in a project to establish a municipal electric lighting plant at Calexico. A committee has been appointed to estimate the cost of plant and system. A.

OXFORD, N. C.—A franchise has been granted to the North State Hydro-Electric Company permitting it to construct and maintain lines in this place. The president of the operating company is Charles Johnson.

LOS ANGELES, CAL.—The Pacific Gas & Electric Company will build two hydroelectric power plants near the $3,000,000 storage reservoir soon to be built in the Sierra Nevada Mountains above Nevada City.

WILMINGTON, MASS.—The town of Reading has signed a contract agreeing to supply light to Wilmington for a period of ten years. About 200 street lights are to be used, at a cost of not more than $2,600 per annum.

FARMINGTON, MINN.—The Farmington Electric Light & Power Company, with F. H. Eddy, vice-president and manager, and C. S. Lewis, secretary, has been organized and is in the market for electrical material of all kinds. C.

AUBURN, CAL.—The Placer Electric Company has purchased a half interest in the Rawhide mine at Towle and the Home Picket mine at Last Chance, and will build a large power plant on the American River near this town.

BEVIER, MO.—A contract has been entered into between D. S. Jones, former mayor, on behalf of the Bevier Commercial Club and Fairbanks, Morse & Company, of St. Louis, for the construction, maintenance and operation of an electric light plant in Bevier.

HOOD RIVER, ORE.—The Pacific Power & Light Company has closed its power plant in Hood River and is now supplying this section from its power plant in White River, by way of The Dalles. A new transmission line has been constructed from The Dalles to Hood River. A.

SAN BERNARDINO, CAL.—A central power plant will be installed with the new polytechnic high school contemplated here. A bond election will be held October 4 to vote bonds for $230,000 for this work. Norman F. Marsh, architect, Los Angeles, has been appointed to prepare plans. A.

SAN DIEGO, CAL.—The City Heights Improvement Association has been made a permanent organization and Walter Kirby has been made president. Arrangements have been made with the San Diego Gas & Electric Company for the immediate installation of an electric street lighting system.

ANDERSON, IND.—The Board of Public Works is in the market for a new steam turbine and electric generator for the municipal electric light plant. The members of the Board are visiting and inspecting other plants before buying. It is proposed to install a turbo-generator costing about $30,000. S.

LIVERMORE, CAL.—President John Desabla and General Superintendent P. C. Funk of the Pacific Gas & Electric Company have been in this city looking over the ground with a view to building here an extensive gas manufacturing plant to supply Livermore and Pleasanton with light and heat.

MISHAWAKA, IND.—The Chapin Park Improvement Association is planning to install a new cluster lighting system for that suburb. The new system will be similar to that in the city of Mishawaka proper, which has been commended so highly. Albert Leisure is president of the Improvement Association. S.

STEINAUER, NEB.—Sealed bids will be received by N. A. Steinauer, village clerk, Steinauer, Neb., until 4 p. m., October 5, for furnishing all material and labor for the construction of a water-works system. Plans and specifications may be obtained from W. E. Donner, Frohberg building, Grand Island, Neb.

ELKHART, IND.—Work has begun on the construction of a modern concrete dam and power house here by the Indiana & Michigan Electric Company. The company has owned the old dam on the St. Joseph River for some time. The new dam will be high enough to make a lake or back-water seven miles long. The work will require eighteen months. S.

OGDEN, UTAH.—Within eight months the mammoth water-power plant of the Davis & Weber Counties Canal Company will be completed and ready for operation, according to the terms of the contract which has been entered into between the canal company and the successful bidder, the Lynch-Cannon Company. The building of the power plant will represent an outlay of $250,000.

MINNEAPOLIS, MINN.—The Council has let the folowing contracts on the installation of an electric light plant at the crematory: The Northwestern Electrical Company, Minneapolis, station equipment, $5,730; pole lines $13,979, and 150 magnetite arc lamps, $4,890; R. B. Whitacre & Company, St. Paul, steam engine equipment $8,781 and Electric Machinery Company, Minneapolis, electric generator $8,279. C.

LOS ANGELES, CAL.—The Board of Public Works will receive bids up to October 23 for machinery for the municipal hydroelectric power plant in San Francisco Canyon, on the line of the aqueduct, including water wheels, generators, exciter units, transformers, and auxiliary electrical equipment. The estimated capacity is 30,000 horsepower. Plans and specifications are on file at the office of the Board, City Hall. A.

EVANSVILLE, IND.—Copies of the articles of incorporation of the Kentucky, Southwestern Light & Power Company have been filed in this and other river cities. The company was incorporated under the laws of Delaware with a capital of $1,570,000. The company has agents acquiring rights of way along the Ohio River in Indiana and Kentucky for the distribution of electric current for light and power purposes. S.

SACRAMENTO, CAL.—The West Sacramento Electric Company, capitalized at $100,000, has filed articles of incorporation. The charter gives the company the right to maintain an electric light and power plant and operate electric lines. The incorporators are: Benjamin P. Lilenthal, San Francisco; Herbert W. Furlong, Pleasanton; William Herlitz, San Francisco; T. T. C. Gregory, Suisun; Council J. Goodsell, San Francisco.

CHIHUAHUA, MEX.—General Luis Terrazas is constructing a large dam upon his ranch thirty miles north of here. It will have a storage capacity of 360,000,000 cubic feet of water, capable of irrigating over 4,000 acres of land. It will also supply energy for a hydroelectric plant which he will install. The power will probably be transmitted to this city and other towns of the state. M. C. Liqournik is the engineer in charge of the construction work. D.

DEL RIO, TEX.—D. B. Chapin and associates, who are preparing to erect a large dam across Devil's River to obtain a water supply for irrigating about 150,000 acres of land and to operate a hydroelectric plant that they will install, have completed the surveys for the proposed works. The dam will be about 185 feet high. The main canal will carry the water over a large scope of country, enabling the reclamation of land that is now unsuited for agriculture. D.

INDIANAPOLIS, IND.—The Merchants' Heat & Light Company has filed notice with the Secretary of State that it has increased the capital stock from $500,000 to $3,000,000. The stock is divided into $500,000 of common stock and $2,500,000 of preferred stock. The officials announce that the proposition to merge the three electric light companies of the city had been given up and the company needed additional capital to develop and take care of the future growth of the company's plant. S.

PENTWATER, MICH.—The Sterns' transmission line to Pentwater and Hart is nearly completed, and the system will probably be in operation by October 1. Coincident with the completion of the transmission line will be the installation of a new 1,000-horsepower turbine generator in the local station. This will increase the generating capacity fifty per cent, there being at present generators to develop 2,000 horsepower.

ELECTRIC RAILWAYS.

(Special Correspondence.)

ST. PAUL.—The St. Paul City Railway Company has been ordered to construct the Maryland street trolley line.

ANTIGO, WIS.—The Wisconsin & Northern railroad has petitioned for a franchise for the construction of a line to Phlox. C.

TAMA, IOWA.—A vote will be taken October 2, on granting a franchise to the Tama & Toledo Railway Company, to construct a line. C.

LOS ANGELES, CAL.—The Los Angeles-Hollywood Homes Company is planning to install a trackless trolley car system on property in the Hollywood section. A.

RIVERSIDE, CAL.—The Board of Public Utilities has been notified that funds have been raised for the extension of the street lighting system on Orange Street, between First and Sixth Streets. The estimated cost is $1,370. A.

PORT ANGELES, WASH.—The Olympic Peninsular Electric Railway Company, recently incorporated, is planning for the construction of its proposed line from Lake Crescent to Port Ludlow. Thomas T. Aldwell, Port Angeles, is president of the company. A.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been granted a franchise for an electric railway from Schuetzen Park to a connection with the South Pasadena city line, near the Cawston Ostrich Farm. Construction work will commence at once. A.

MT. AYR, IND.—Eugene Purtelle, who is promoting and constructing an interurban road from Lafayette to Chicago, has moved his construction camp and force of men from Wheatfield to this place. Mr. Purtelle reports that about seven miles of road has been graded and that the work will be pushed rapidly. S.

MADISON, IND.—The Cincinnati, Madison & Western Traction Company has purchased the Madison Light & Railway Company's plant, including the local street-car system. This purchase and transfer is said to mean the immediate construction of the traction road from Scottsburg to Madison, work on which has been in progress for nearly a year.

INDIANAPOLIS, IND.—The Board of Commissioners of Marion County has granted a fifty-year franchise to the Indianapolis & Delphi Traction Company to build a traction line from the city limits north along the range line to the Hamilton County line. Henry L. Smith, who represents the incorporators, says work will begin on the line in a few weeks. S.

CRAWFORDSVILLE, IND.—The Crawfordsville & Danville Interurban Association is busy with the preliminary surveys of a line to connect the Indianapolis, Crawfordsville & Western Traction Company with the McKinley system at Danville, Illinois. This line, when completed, will close the gap between Indianapolis and St. Louis, for trolley service. S.

ANDERSON, S. C.—Plans to construct an electric road from Abbeville to Easley, sixty miles in length, passing through the city of Anderson, have taken definite shape, and it is believed that within a short while the work will be under way. The proposed route traverses some of the best farming country in the Piedmont region. It will cost approximately $800,000.

VINCENNES, IND.—It is reported that the Brinely Construction Company of New York has entered into a contract with officials of the Vincennes, Washington and Eastern Traction Company to complete the line between Vincennes and Loogootee. Four and one-half miles of the grade was completed by the Canadian Construction company before it gave up the contract. S.

NEW ALBANY, IND.—F. E. Seagraves of Toledo, who has constructed several interurban lines in Ohio and Indiana, is arranging to contract to build an interurban road from New Albany to Paoli, French Lick and West Baden Springs. Mr. Seagraves has gone over the route carefully and reports the construction of the line feasible and is ready to undertake the work. S.

DES MOINES, IOWA.—The street railway company let the contract to the J. W. Turner Improvement Company, for the construction of an addition to the power plant, 30 by 60, and the concrete work on a coal bin at $54,000, and a new low-presure turbine to be installed by the Henry Worthington Company, of New York City, to the General Electric Company of Schenectady, N. Y., at $50.000.

WATERBURY, CONN.—It is reported that the New Haven is seriously considering the electrification of the entire Naugatuck Division. A committee which petitioned the company for electrification between Torrington and Thomaston was informed that the company was not only considering the matter presented in the petition, but had also taken up plans for electrifying the Naugatuck Division.

WENATCHEE, WASH.—The Wenatchee Traction Company has been granted a franchise for an electric railway on certain streets in Wenatchee. The company will post a deposit of $5,000 to insure the commencement of construction within six months. The line will be built, it is said, along the Columbia River Valley, with extensions to make a total distance of about 100 miles. Louis W. Pratt, of Tacoma, is president. A.

SOUTH BEND, IND.—The City Council has taken steps to separate the grade crossings of interurban and steam roads in this city. Grade separation is made possible in this city under the provisions of a law passed by the last legislature affecting South Bend in particular. The city and interurban line of the Northern Indiana Railway crosses the Lake Shore steam line and a number of prominent streets. These will be bridged or subways constructed. The interurban road will bear fifteen per cent of the cost. S.

TERRE HAUTE, IND.—The prospect for a through trolley system between Indianapolis and St. Louis, by way of Terre Haute, has been greatly enhanced by a recent conference of traction men in this city. I. A. Smith, president of the Springfield and Central Illinois Traction Company; William C. Newhauer of St. Louis, representing traction interests, projecting a traction line from St. Louis to Terre Haute, have applied to the county and city officials for the use of the Wabash bridge and an entrance to the city. They assured the officials that the proposed line will have ample capital to build and operate the road. S.

SACRAMENTO, CAL.—The Pacific Electric Railway Company of Los Angeles, has been incorporated with authorized capitalization of $100,000,000, as a merger of various interurban trolley lines controlled by Southern Pacific Company in Southern California. The new company will bring into one system, with a single management, lines which have hitherto been operated separately, and the change is expected to increase materially the efficiency of operation and result in considerable reduction of operating expenses. Among lines which figure in merger are the Pacific Electric Railway, Los Angeles Pacific Company, Los Angeles & Redondo Railway, Los Angeles Interurban Railway, Riverside & Arlington, San Bernardino Valley Traction Company, Redlands, Central Railway and San Bernardino Interurban Railway. Plans have been approved, it is announced, for expenditure of about $30,000,000 for new construction, the purpose being to increase the total length of lines from 1,000 miles to 2,000 miles. Extension work is to be done gradually, however, and it is understood that no financing in connection with it is contemplated in the immediate future. Incorporators of new company are William F. Herrin, R. C. Gillis, W. C. Martin, Epes Randolph and Paul Shoup, all Southern Pacific officials.

TELEPHONE AND TELEGRAPH.

(Special Correspondence.)

SHELL LAKE, WIS.—M. E. Albee has purchased the local telephone system and will improve it. C.

CULBERTSON, MONT.—The Moore Telephone Company is constructing a long-distance line through the northern part of the state of Montana. C.

MILES CITY, MONT.—The Bell Telephone Company, of which S. B. Green is manager, is planning the extension of its system up the Tongue River. C.

LITTLE FALLS, MINN.—The Morrison County Telephone Company, John Stroman, manager, is constructing a ten-mile extension of its line to Vawter. C.

LAPORTE, CAL.—The construction of a new telephone line to the Bellevue mine near Gibsonville and to the Tamarac Flat station has been started by the Forest Service.

DICKINSON, N. D.—The German-Hungarian Telephone Company has been organized to connect Lefor, Gladstone and several places in Hettinger County by telephone. C.

NEVADA CITY, CAL.—The Pacific Telephone & Telegraph Company will soon begin the construction of a new telephone line from Comptonville, Yuba County, to Loyalton, Sierra County.

MARTINEZ, CAL.—The Mt. Diablo Telephone Company has been incorporated with a capital stock of $5,000. H. C. Wetmore has been made president, Charles Gordon secretary and Percy Douglas treasurer.

ESCONDIDO, CAL.—The San Diego County Mutual Telephone & Telegraph Company has been incorporated for $100,000. This company will build a line to connect with the long-distance Home Telephone line at Oceanside.

WESTON, ORE.—The Pacific Telephone & Telegraph Company is planning to rebuild its system in this district. A new switchboard will be installed at the local exchange. A franchise has been requested from the City Council. A.

NAPA, CAL.—The residents of Monticello are co-operating with the business people of the Cappell and Wooden Valley districts and the city of Napa for the installation of a direct telephone line between Monticello and Napa.

ABERDEEN, WASH.—The Pacific Telephone & Telegraph Company has awarded a contract for the erection of a new telephone building here to Westerfield & VanBuskirk, Tacoma, at a price of $35,000. The company will also make improvements and extensions in its station on Eleventh Avenue. A.

LOS ANGELES, CAL.—With a view to testing the possibilities of physical connection between the two local telephone systems, Bell and Automatic, the Board of Public Utilities has requested permission to install five trunk lines of each, leading to a central exchange in the municipal building, and allowing subscribers of one system intercommunication at nominal toll. The experiment is to be continued for one year and is estimated to cost the city about $5,000. A.

ELECTRICAL SECURITIES.

At the annual meeting of the Philadelphia Rapid Transit Company directors were re-elected. A majority of the stock is now held by voting trustees.

At the annual meeting of the Union Traction Company directors were re-elected. In all, 355,150 shares were voted. There were about thirty stockholders present. No other business was transacted.

The Trenton Street Railway Company has issued $300,000 general mortgage six per cent gold bonds for the improvement and betterment of the property. These bonds have been purchased and are now being offered by C. E. Mitchell & Company, 37 Wall Street, New York, at 101 and interest. Net earnings of the company reported for the first half of 1911 indicate a considerable increase over the previous year.

Since the fiscal year closed, Northwestern Elevated made a new mortgage covering all property to secure $25,000,000 bonds. All the new bonds have been issued and sold and proceeds have been or will be devoted to the payment and discharge of bonds maturing September 1, other indebtedness and other corporate purposes. At the annual meeting of the Northwestern Elevated stockholders directors Gulick, Cobe and Starling were re-elected. The board met later and re-elected officers.

A Commonwealth Edison circular says that stockholders of record October 14 may subscribe for new stock at par to the extent of fifteen per cent, payable quarterly, as previously announced. Subscription receipts issue upon first installment payment, November 1, and new stock certificates issue August 1, next year, dividends applying in the meantime only to amounts actually paid in, while advance deposits are entitled to five per cent interest after ten days and until due. Fractional scrip will issue August 1 without dividend or voting privilege until presented in amounts equal to full shares within six months thereafter.

It is thought that the fiscal year of the American Telephone Company drawing to a close will show about twelve per cent for the stock, and that the company will go over the first of January with the largest cash balance in its history, around $50,000,000. The modest construction requirements this year make it improbable that the company will need to do any more financing before the latter part of 1913. This year the subsidiary companies have drawn on the parent company for only about one-half of the money they would ordinarily need.

DIVIDENDS.

American Gas & Electric Company, regular quarterly dividends of one and one-half per cent on the common and preferred stocks. The dividend on the common stock is payable October 2 to stockholders of record September 22, and on the preferred stock, November 1, to stockholders of record October 20.

American Power & Light Company, regular quarterly dividend of one and one-half per cent on the preferred stock, payable October 2.

American Telephone & Telegraph Company, regular quarterly dividend of two per cent, payable October 16 to stock of record September 30.

Aurora, Elgin & Chicago Railway Company, common quarterly dividend of three-quarter per cent and preferred quarterly dividend of one and one-half per cent, both payable October 10.

Bell Telephone Company of Missouri, a dividend of one per cent, payable October 2.

Bangor Railway & Electric Company, quarterly dividend of one and three-quarters per cent, payable October 1.

Central & South American Telegraph Company, quarterly dividend of one and one-half per cent, payable October 7.

Cities Service Company, regular monthly dividends of one-half of one per cent on the preferred stock and one-quarter of one per cent on the common, both payable October 1 to stock of record on September 20.

Cincinnati & Hamilton Traction Company, common quarterly dividend of three-quarters per cent, and preferred quarterly dividend of one and one-quarter per cent, both payable October 2.

Cincinnati Street Railway Company, quarterly dividend of one and one-half per cent, payable October 2.

City Railway Company, Dayton; common quarterly dividend of one and three-quarters per cent, and preferred quarterly dipidend of one and one-half per cent, payable October 2.

Cumberland Telephone & Telegraph Company; regular quarterly dividend of two per cent on the capital stock, payable October 2 to stock holders of record September 20.

Dayton & Troy Electric Railway Company; common quarterly dividend of one and one-quarter per cent, and preferred dividend of one and one-quarter per cent, both payable September 30.

Electric Storage Battery Company; regular quarterly dividends of one per cent on the preferred and common stock, payable October 2 to stock of record September 23.

Electrical Securities Corporation; common quarterly dividend of two per cent; preferred quarterly dividend of one and one-quarter per cent; the former payable September 30, and the latter November 1.

Electrical Utilities Corporation; preferred quarterly dividend of one and one-quarter per cent, payable October 16.

Illinois Traction Company; preferred quarterly dividend of one and one-half per cent, payable October 2.

Kansas City Gas & Electric Company; preferred quarterly dividend of one and three-quarter per cent, payable October 2.

Massachusetts Lighting Companies; quarterly dividend of one and three-quarters per cent, payable October 16.

Mexican Telegraph Company; quarterly dividend of two and one-half per cent, payable October 14.

National Carbon Company; common quarterly dividend of one and one-half per cent, payable October 14.

National Gas, Electric Light & Power Company; preferred quarterly dividend of one and one-half per cent, payable October 2.

Nebraska Telephone Company; quarterly dividend of one and one-half per cent, payable October 10.

New England Telephone & Telegraph Company; regular quarterly dividend of one and three-quarters per cent, payable September 30 to stock of record September 19.

Niagara Falls Power Company; regular quarterly dipidend of $2 per share on the capital stock, payable October 16 to stockholders of record September 30.

Ohio Traction Company; common quarterly dividend of one per cent, payable October 2.

Oklahoma Railway Company; quarterly dividend of one and one-quarter per cent, payable October 1.

Otis Elevator Company; regular quarterly dividends of one and one-half per cent on the preferred stock and one per cent on the common, payable October 16 to stock of record September 30.

Ottawa Light, Heat & Power Company; quarterly dividend of one and three-quarters per cent, payable October 2.

Philadelphia Company; regular quarterly dividend of one and one-half per cent on the common stock, payable November 1 to stock of record October 2.

Portland (Me.) Railroad Company; semi-annual dividend of two per cent, payable October 2.

Public Service Corporation of New Jersey; quarterly dividend of one and one-half per cent, payable September 30.

Ridge Avenue Passenger Railway Company; regular quarterly dividend of $3 per share, payable October 2 to stock of record September 16.

Stark Electric Company, quarterly dividend of three-quarters per cent, payable October 2.

Union Traction Company of Indiana; semiannual dividend of two and one-half per cent on the preferred, payable October 1 to stock of record September 25.

United Light & Railways Company; first-preferred quarterly dividend of one and one-half per cent, and preferred of three-quarters per cent, both payable October 2.

Washington Water Power Company; quarterly dividend of two per cent, payable October 2.

CLOSING BID PRICES FOR ELECTRICAL SECURITIES ON THE LEADING EXCHANGES AS COMPARED WITH THE PREVIOUS WEEK.

NEW YORK.

	Sept. 25	Sept. 18
Allis-Chalmers common	6	6¼
Allis-Chalmers preferred	15	17½
Amalgamated Copper	48⅞	57⅝
American Tel. & Cable	*78⅜	*78⅜
American Tel. & Tel.	134¼	135½
Brooklyn Rapid Transit	73⅜	73⅞
General Electric	145	150
Interborough-Metropolitan common	13½	14¾
Interborough-Metropolitan preferred	41¼	42⅝
Kings County Electric	129	129
Mackay Companies (Postal Telegraph and Cables) common	82	82
Mackay Companies (Postal Telegraph and Cables) preferred	72¼	73
Manhattan Elevated	131	132
Metropolitan Street Railway	*18	*18
New York & New Jersey Telephone	103	103
Pacific Tel. & Tel.	35½	37
U. S. Steel common	56⅛	68⅛
U. S. Steel preferred	105¾	114¾
Western Union	76	76¾
Westinghouse common	59⅝	62
Westinghouse preferred	111¼	110¼

*Last price quoted.

BOSTON.

	Sept. 25	Sept. 18
American Tel. & Tel.	134⅛	134½
Edison Elec. Illuminating	280	280
General Electric	144½	149½
Massachusetts Electric common	16¾	17¼
Massachusetts Electric preferred	87	88
New England Telephone	143¼	147
Western Tel. & Tel. common	16	16¼
Western Tel. & Tel. preferred	95	96½

PHILADELPHIA.

	Sept. 25	Sept. 18
American Railways	44	44
Electric Company of America	11⅝	11¾
Electric Storage Battery common	49¾	51¾
Electric Storage Battery preferred	49¾	51¾
Philadelphia Electric	16¼	16¼
Philadelphia Rapid Transit	21¼	22
Philadelphia Traction	81¾	82
Union Traction	49	49¾

CHICAGO.

	Sept. 25	Sept. 18
Chicago Elevated Rys. common	24	24
Chicago Elevated Rys. preferred	88	88
Chicago Railways, Series 1	85	90
Chicago Railways, Series 2	28	29
Chicago Subway	1½	2½
Chicago Telephone	118	121
Commonwealth Edison	134	135
National Carbon common	101	100
National Carbon preferred	117	115

PERSONAL MENTION.

GEORGE W. FORD has been appointed manager of the Portland, Eugene & Eastern Railway, with offices at Eugene, Ore.

CHARLES D. KAEDING has been appointed superintendent of the mechanical and electrical departments of the Goldfield Consolidated Mining Company, Goldfield, Nev.

T. C. MARTIN, of New York, secretary of the National Electric Light Association, is at Seattle, Wash., in the interests of the national convention to be held there in June, 1912.

GEORGE D. O'CONNOR, formerly manager of the Portland, Eugene & Eastern Railway, has been appointed to the same position with the Corvallis & Alsea Railway Company at Corvallis, Ore.

THOMAS A. EDISON was given a banquet at Berlin, Germany, by the American Association of Commerce and Trade of Berlin. Mr. Edison sailed for home on the *Amerika*, which left Hamburg September 27.

JOHN PRICE JACKSON, dean of the school of engineering, of Pennsylvania State College, was elected the first honorary member of the Pennsylvania Electric Association at its recent meeting. The honor conferred upon Professor Jackson is well-merited.

GEORGE A. HUGHES, president of the Hughes Electric Heating Company, Chicago, has just returned from a six weeks' trip to the Pacific Coast. Mr. Hughes found that central-station men in the territory visited were greatly interested in heating devices and that business is brisk.

WILLIAM S. TAUSSIG, who for the past six months has been connected with the General Electric Company of Texas, at Dallas, is in Chicago for a brief visit. Mr. Taussig was formerly with the General Electric Company at Chicago and is a past secretary of the Chicago Electric Club.

H. D. MURDOCK, who resigned recently as superintendent of the Indianapolis & Louisville Traction Company, with headquarters at Scottsburg, Ind., has accepted a position with the Westinghouse Electric & Manufacturing Company at Pittsburgh, Pa. Mr. Murdock is the inventor of a number of electric devices.

J. D. DOUGLAS, manager of a suburban line running out of Auckland, New Zealand, recently arrived at San Francisco on board the *Maitai*. Mr. Douglas will inspect several lines in the United States with a view to purchasing suitable generating machinery for his company, which proposes to electrify its steam lines.

S. G. NEILER presented a paper before the joint meeting of the Western Society of Engineers and the American Institute of Electrical Engineers at Chicago on September 27. Mr. Neiler's paper took up the description of the electrical and mechanical equipment of the new terminal of the Chicago & Northwestern Railway.

C. R. VINCENT, for many years president of the Ball & Wood Company, has assumed the managership of the Monel-metal department of the Ruggles-Coles Engineering Company, 50 Church Street, New York City, general agents for the Bayonne Casting Company. At its foundry in Bayonne, N. J., the latter company has for some years been making with success castings of this remarkable alloy that is stronger than steel and less corrodible than bronze.

CLAUDE E. COX has resigned his position as factory manager of the H. E. Wilcox Motor Car Company, Minneapolis, Minn., and joined the organization of Arthur D. Little, Inc., of Boston, as resident manager of the engineering laboratories, which this organization of chemists and engineers is conducting for the General Motors Company, Detroit, Mich. Mr. Cox is well known as the designer of the "Overland" and "Interstate" cars, and will bring to his new position an intimate knowledge of motor-car construction.

GEORGE C. SMITH, for the past ten years connected with the Westinghouse Companies, in charge of auxiliary organizations, who resigned September 1, will be succeeded by Calvert Townley, assistant to the president of Westinghouse Electric & Manufacturing Company. Mr. Smith retired to give his entire attention to other enterprises in which he is interested, as a member of the engineering and constructing firm of James Stewart & Company and New York representative of the Canada Syndicate, Ltd., of Montreal and Toronto.

NEW INCORPORATIONS.

WARREN, O.—The National Electric Welder Company has been incorporated with a capital of $40,000 by Fred P. McBerthy, A. C. Taylor, William A. Wilson, B. E. Wolcott and T. H. Gillmer.

CHICAGO, ILL.—The Florence Electric Tray Company has been incorporated with a capital of $75,000 to manufacture and deal in electric trays and other specialties. The incorporators are Florence L. Crombie, William H. Benes and Ernar C. Howard.

CHICAGO, ILL.—The Midland Electric Heating Company, incorporated with a capital stock of $10,000, will do a general electrical manufacturing business. The incorporators are Richard W. Thornton, Julius Goldzier and Henry Hiestand.

CHICAGO, ILL.—The Maxant Engineering & Manufacturing Company, which was recently incorporated with a capital of $10,000, will engage in manufacturing electrical and mechanical goods. The incorporators are Basil Maxant, Frank Maxant, and William D. Johnson.

PROPOSALS.

FIXTURES.—The Board of Supervisors at Los Angeles, Cal., will receive bids until October 9 for furnishing and installing electric-lighting fixtures in the County Home of Detention Building. Hudson & Munsell, of Los Angeles, are the architects.

SUPPLIES.—The Navy Department, Bureau of Supplies and Accounts, Washington, D. C., will receive bids on the material listed below until October 17. In sending for schedules the number should be mentioned:

Article.	Quantity.	Delivered at navy yard.	Schedule No.
Annunciators, water-tight	9.	Mare Island, Cal.	3944
Appliances, wiring	Semian'l supply	Various	3944
Bells and buzzers, water-tight.	do	do	3944
Bells and buzzers, nonwater-tight.	do	do	3944
Board, fuller	100 pounds	Puget Sound, Wash.	3944
Boxes, connection	Semian'l supply	Various	3944
Boxes, junction	do	do	3944
Bushings, hard rubber	2,650.	do	3944
Bushings, porcelain	900.	Mare Island, Cal.	3944
Button, push	Semian'l supply	Various	3944
Carbon, plate	12 pieces	Mare Island, Cal.	3944
Carbons, searchlight	2,300.	do	3944
Cells, dry	Semian'l supply	Various	3944
Conduit, brass	do	do	3943
Conduit, steel	do	do	3943
Controllers, hoist, lower	20	Brooklyn and Newport News.	3954
Controllers, truck light	12	Various	3944
Elbows, pipe, steel	Semian'l supply	do	3943
Fiber	do	do	3944
Fittings, conduit, brass	do	do	3943
Fittings, conduit, iron and steel.	do	do	3944
Fittings, interior	do	do	3944
Fuses, glass tube	do	do	3944
Fuses and fuse wire	do	do	3944
Generators, testing	22	do	3944
Globe, shades, etc	Semian'l supply	do	3944
Hangers, insulator	1,700	Portmouth, N. H. and Brooklyn, N. Y.	3944
Insulators and bushing, electrose.	305	Brooklyn, N. Y.	3944
Irons, flat, soldering, etc	Semian'l supply	Various	3944
Jacks, telephone	do	do	3944
Keyboards, night signal	25	do	3944
Lanterns, light fixtures	Semian'l supply	do	3944
Mica and micanite	585 pounds	Mare Island and Puget Sound.	3944
Plugs, attachment, etc	Semian'l supply	Various	3944
Portables	do	do	3944
Pots, soldering, electric	3	Philadelphia and Norfolk, Va.	3944
Reflectors, prismatic	Semian'l supply	Various	3944
Rubber, hard, sheet, etc	do	Mare Island and Puget Sound.	3944
Sets, portable, testing	3	Philadelphia, Pa.	3944
Set, portable, ventilating	16 sets	Various	3944
Slate, beveled and polished	5 slabs	Mare Island, Cal.	3944
Snakes, steel	25	do	3944
Sockets, key	Semian'l supply	Various	3944
Sockets, lamp	do	do	3944
Sockets and receptacles	do	do	3944
Strips, searchlight	48 sets	Boston and Mare Island, Cal.	3944
Supplies, electrical	Miscellaneous	Washington, D. C.	3953
Supplies, telephone pole	do	do	3953
Switches, cut-out, etc	Semian'l supply	Various	3944
Switches and receptacles	do	do	3944
Terminals, wire	41,000	do	3944
Tubes, terminal and stuffing	Semian'l supply	do	3944
Unions, malleable iron	do	do	3944
Wire, magnet	do	do	3944
Wire, rubber covered, etc	9,000	Washington, D. C.	3953
Wire, weatherproof	18,000 feet	do	3953

INDUSTRIAL ITEMS.

ARTHUR S. PARTRIDGE, St. Louis, Mo., lists a varied line of electric and steam machinery in its list No. 38, for September, 1911.

THE FEDERAL SIGN SYSTEM (ELECTRIC), Chicago, reproduces in the September number of the *Federalist* a picture taken in Colonel Andrew's diamond palace, San Francisco. Federal clamp sockets were used throughout the store.

MAC GOVERN, ARCHER & COMPANY, New York, N. Y., has issued its September list of electrical and steam machinery, cars and equipment. The company has a large amount of second-hand machinery in good condition and ready for immediate shipment.

THE HARRISON SAFETY BOILER WORKS, Philadelphia, Pa., announce their new back-pressure valve for heating systems, their atmospheric relief valve for vacuum service, and the Cochrane multiport safety exhaust outlet valve for back-pressure and relief service.

THE TERRY STEAM TURBINE COMPANY announces the appointment of J. S. Cothran, of Charlotte, N. C., as sales agent for North and South Carolina. Mr. Cothran's office will continue to be at Charlotte, N. C., where he has long been identified with the trade.

THE DELTA-STAR ELECTRIC COMPANY, Chicago, Ill., is distributing a new catalog describing a full line of Mazda lighting fixtures for indoor and weatherproof service. Photometric curves are given, with the aid of which proper reflectors can easily be selected for a given installation.

THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia, Pa., describes the installation of the chloride accumulator for the Goldfield Consolidated Mines Company of Goldfield, Nev., in a

recent publication. A map of the system, diagram of connections, and a number of curves are reproduced.

THE McROY CLAY WORKS, Chicago, Ill., supplied the vitrified conduits in which the cables supplying the ornamental lighting system along Michigan Boulevard, Chicago, are laid. This interesting boulevard-lighting system was described in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN, in the issue of September 16.

LOCKWOOD, GREENE & COMPANY, architects and engineers for industrial plants, 93 Federal Street, Boston, have just established a Chicago office in the First National Bank Building, Chicago. This will be under the managership of Harold V. Coes, until recently mechanical engineer for the Liquid Carbonic Company.

THE REYNOLDS ELECTRIC FLASHER MANUFACTURING COMPANY, Chicago, Ill., announces the opening of a branch office for the trade on the Pacific Coast, in the Electric Building, San Francisco, Cal. Henry F. Frosch will be in charge. This new coast office will carry a complete stock of standard types of flashers for immediate deliveries.

THE HURLEY MACHINE COMPANY, Chicago, Ill., has prepared a data sheet, showing the number of central stations of various types in the United States. There are, according to the figures of the company, 5,718 central stations at present in operation in this country, and the fact is especially noted that of this number 1,586 are selling "Thor" electric home-laundry machines as a special inducement for gaining new business.

THE INTERNATIONAL OXYGEN COMPANY has removed its New York headquarters from 68 Nassau Street to 115 Broadway, where increased facilities have been secured for transacting its steadily growing business. The new location is especially well fitted for the company's needs and is easy of access for parties who, on coming into New York City, may want to investigate the methods of the I. O. C. system of oxygen and hydrogen manufacture for commercial purposes.

THE LEEDS & NORTHRUP COMPANY, Philadelphia, Pa., has published Catalog No. 44, describing its resistance boxes and Wheatstone bridges. In addition to the actual description of the apparatus, the methods of constructing various types of boxes are taken up. The company's faultfinder is described in Catalog No. 54. Three methods of finding faults, two Murray loop methods and the Varley loop method, are explained and described with the aid of diagrams. The location of opens with the L. & N. faultfinder and other tests are also considered.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., has adopted a magnetic slot bridge as a means of securing high induction-motor efficiencies while making use of open slots and form-wound coils. Both the bridge and its method of construction are explained in a booklet under the title "Induction Motors," recently issued by the company. A number of points of interest and several features of the Crocker-Wheeler motors which have not been generally understood by the trade in general are taken up and explained in full.

THE CONNECTICUT TELEPHONE & ELECTRIC COMPANY and THE CONNECTICUT SHOCK ABSORBER COMPANY of Meriden, Conn., have jointly opened up a new branch at 819-A Boylston street, Boston, Mass., under the management of William A. Ellis, who was formerly sales manager for the Bi-Motor Equipment Company of Boston. Mr. Ellis has been identified with the automobile trade almost since the start and is very well known by the trade throughout New England. The Connecticut Company will carry on hand in its Boston office a large stock for the accommodation of the trade.

THE ADAMS-BAGNALL COMPANY, Clesveland, O., is distributing folders in which are described the company's ABolites. The primary characteristic of this specialty is the provision of a metal reflector support to replace variable holders. To this is applied a patented positioning device attached to a suitable porcelain receptacle. The ABolite is a single unit performing the function of socket, shade-holder and fixture for practically all conditions of singe unit illumination. Catalog No. 100 lists the A-B regenerative flame lamps. A folder issued at the same time gives the names of a number of large users of these lamps.

THE WHEELER CONDENSER & ENGINEERING COMPANY, Carteret, N. J., has published a new edition of its bulletin on the Wheeler-Edwards air pump for operation in connection with surface condensers, handling both the air and condensed steam. The function of the air pump and its relation to the condenser proper are first taken up, then the construction and operation of the Wheeler-Edwards air pump, and a comparison of the efficiency of the Wheeler-Edwards air pump with other types of pumps handling air and condensate are discussed in detail. The pages following are devoted to the various uses for the pump.

DATES AHEAD.

Empire State Gas and Electric Association. Annual meeting, New York City, October 6.

American Electric Railway Association and affiliated associations. Annual convention, Atlantic City, N. J., October 9-13.

National Association of Railway Commissioners. Twenty-third annual convention, Washington, D. C., October 10.

New York Electrical Exposition, New Grand Central Palace, New York, N. Y., October 11-21.

American Physical Society. Next regular meeting, New York City, October 14.

Denver Electric Show. Denver, Colo., October 14-21.

Order of the Rejuvenated Sons of Jove. Denver, Colo., October 16-18.

American Mining Congress. Fourteenth annual meeting, Chicago, Ill., October 24-28.

Illinois State Electric Association. Annual convention, Rockford, Ill., October 24, 25 and 26.

Association of Railway Electrical Engineers. Annual convention, La Salle Hotel, Chicago, November 6-10.

National Electric Light Association. Next annual convention, Seattle, Wash., June 10-14, 1912.

RECORD OF ELECTRICAL PATENTS.

Issued (United States Patent Office) September 19, 1911.

1,003,416. REGULATOR. John C. Barry, Schenectady, N. Y., assignor to General Electric Co. Filed Sept. 13, 1907. A booster in series with a storage battery has two differential shunt fields connected together through a resistance, a variable contact point of which is connected to the opposite side of the battery by means of a contact arm actuated by an electromagnet in series with the load circuit.

1,003,424. IGNITION SYSTEM FOR MULTICYLINDER INTERNAL-COMBUSTION ENGINES. Rufus L. Bond, Gary, Ind. Filed May 17, 1909. Consists of a number of spark-drawing devices, actuating magnets for them, and energizing circuits for the magnets, each circuit including one of the magnets and one of the devices actuated by another of the magnets.

1,003,429. APPARATUS FOR TRANSMITTING HALF-TONE PICTURES. Henri Carbonnelle, Uccle, near Brussels, Belgium. Filed March 13, 1907. A supporting arm carries a tracer adapted to move over a plate having a deposit of variable conductivity. The arm, tracer, plate and plate support are in a series circuit connected to a distant receiving instrument.

1,003,430. SWITCH. Roscoe Cawyer and James D. Gattis, Mercury, Tex. Filed January 14, 1911. A spring-controlled switch for connecting a telephone party line either to the bell circuit or to the talking circuit.

1,003,431. SYSTEM OF MOTOR CONTROL. Alexander Churchward, New York, N. Y., assignor to General Electric Co. Filed April 9, 1909. A controller for connecting up the machine as a series motor for normal operation and as a cumulative-compound generator for regenerative braking.

1,003,453. MERCURY METER. Edward S. Halsey, Nahant, Mass., assignor to General Electric Co. Filed April 22, 1908. Consists of a cup-shaped armature revolving in the mercury, a magnetic member surrounding the armature, and two U-shaped permanent magnets with two of their sides fastened together so as to form a consequent pole extending within the armature and their other two sides fastened to the magnetic member surrounding the exterior of the armature.

1,003,455. ELECTRIC-ALARM LUBRICATOR. William A. Hardwick, Memphis, Tenn. Filed March 8, 1909. A compression lubricator in which an insulating piston is used together with an insulated sleeve about the piston-rod. The barrel and the cap of the piston rod are connected to an alarm circuit that is closed when the oil is all used up.

1,003,456. ELECTROLYTIC APPARATUS. Louis H. A. B. M. Hazard-Flamand, Boulogne-sur-Seine, France, assignor to International Oxygen Co. Filed February 6, 1911. Combined with the electrodes is an absorbent diaphragm between them, a fluid seal about both sides of the top of the diaphragm, and means simultaneously delivering the agent to be decomposed on opposite sides of the diaphragm.

1,003,464. SYSTEM OF MOTOR CONTROL. Leopold Janisch and Willy Linke, Berlin, Germany, assignors to General Electric Co. Filed May 7, 1909. Includes a motor, a generator supplying current thereto and having a separately-excited field, and a separately-excited exciter mechanically driven by the motor and supplying current to the field winding of the generator.

1,003,465. ALTERNATING-CURRENT MOTOR. Carlton L. Kennedy, South Braintree, Mass., assignor to Holtzer-Cabot Electric Co., Brookline, Mass. Filed Dec. 13, 1909. A single-

phase motor has a starting and a working winding on the rotor brushes are short-circuited, thus cutting out the starting winding.

1,003,468. DASH ELECTRIC HEADLIGHT. John Kirby, Jr., Dayton, O., assignor to United States Headlight Co., Buffalo, N. Y. Filed April 10, 1911. A removable headlight for an electric car.

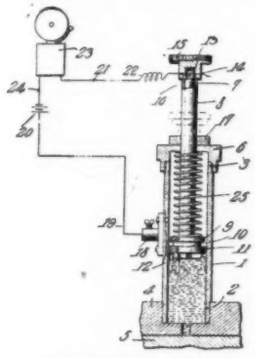
1,003,476. TELEPHONE SYSTEM. Albion D. T. Libby, Elyria, O., assignor to Dean Electric Co., Elyria, Ohio. Filed July 15, 1909. An intercommunicating system has an attendant's station connected to the main trunk through a slow-acting relay.

1,003,502. FREQUENCY-METER. Arthur F. Poole, Chicago, Ill. Filed May 11, 1908. A speed counter contains an electromagnetic clutch for connecting the counting mechanism with the driving device. A clock train closes and opens the clutch circuit, so that the speed is determined for an exact predetermined time interval.

1,003,506. VARIABLE-RATE METER. William H. Pratt, Lynn, Mass., assignor to General Electric Co. Filed April 18, 1903. Comprises a movable element and retarding devices arranged to cause the meter to record at one rate for loads not exceeding a predetermined value and at a different rate for those exceeding this value.

1,003,507. ASTATIC WATTMETER. William H. Pratt, Lynn, Mass., assignor to General Electric Co. Filed Jan. 25, 1910. Has two four-pole armatures mounted on a vertical shaft and each inclosed in four-pole series field. The armatures and fields are so positioned that the flux of one set is opposed to that of the other.

1,003,547. TRANSFORMER SECONDARY. Elihu Thomson, Swampscott, Mass., assignor to Thomson Electric Welding Co., Lynn, Mass. Filed Aug. 5, 1909. The secondary consists of a pair of bars containing a knuckle joint having the knuckles of opposite members spanned or bridged by a piece of conducting material spring-pressed against them.



1,003,455.—ELECTRIC ALARM FOR LUBRICATOR.

1,003,586. VENTILATED FUSE PLUG. Frank C. Curtis, Troy, N. Y. Filed Jan. 19, 1911. Combined with the body of the plug and a cap secured thereto is a ventilating packing of incombustible material pervious to the passage of gases interposed between the body and cap.

1,003,600. REGULATION OF DYNAMO-ELECTRIC MACHINERY. Heinrich Guttinger, Baden, Switzerland, assignor to Aktiengesellschaft Brown, Boveri & Cie., Baden, Switzerland. Filed Jan. 16, 1909. An automatic regulator consists of a set of contacts and resistances connecting them, an operating sector adapted to roll over the contacts, a shaft, an electrically controlled rotatable member mounted thereon, and elastic means connected to the shaft and transmitting the movement of the rotatable member to the point of the sector.

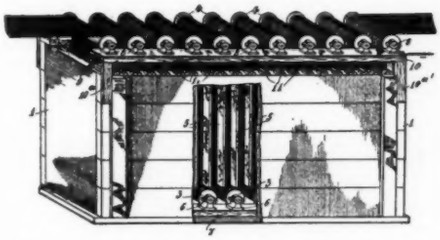
1,003,604. ELECTROLYTIC PROTECTION. Albert B. Herrick, New York, N. Y. Filed Oct. 2, 1909. This method of preventing electrolysis of an earth conductor adjacent a grounded return consists in alternately connecting the earth conductor to the grounded return and to a source of negative electromotive force.

1,003,633. INDUCTION COIL. John McIntyre, Jersey City, N. J. Filed March 21, 1908. Has a clamped bar and a vibrator adapted to contact with it, the bar being slidable and rotatable when unclamped.

1,003,634. INDUCTION COIL. John McIntyre, Jersey City, N. J. Filed Oct. 24, 1908. Similar to the above, except that the contact bar is non-rotatable.

1,003,649. INDUCTOR GENERATOR FOR IGNITION PURPOSES. Henry Joseph Podlesak, Chicago, Ill., and Tesla Emil Podlesak, Morristown, N. J. Original application filed September 25, 1901. Divided and this application filed Jan. 28, 1908. Has a permanent magnet with a pair of luminated pole pieces and a coil wound on a polar projection of each pole piece. A rotating inductor varies the magnetic flux through the coils.

1,003,659. ELECTROPLATING OF WIRE CLOTH. Francis J. Root, New York, N. Y., assignor to New York Wire Cloth Co., New York, N. Y. Filed June 2, 1911. The method consists in passing a long strip of wire cloth in a continuous path through a bath having therein anodes arranged so that they are opposite the flat surfaces of the cloth and supplying an electric current which passes in at the anodes and out of the cloth at several different points along its travel.



1,003,659.—ELECTROPLATING WIRE CLOTH.

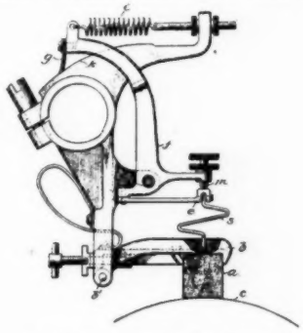
1,003,673. ELECTRIC FUSE. John A. Tornquist, Davenport, Iowa. Continuation of application filed March 29, 1910. This application filed June 22, 1911. An inclosed cartridge fuse with knife-blade terminals.

1,003,676. ELECTROTHERAPEUTIC DEVICE. Julius B. Wantz, Chicago, Ill., assignor to Victor Electric Co., Chicago, Ill. Filed Oct. 21, 1909. A cylindrical resistance with a zigzag circumferential contact against which bear two circuit terminals adapted to move back and forth in opposite directions when the cylinder is turned.

1,003,677. PUSH-BUTTON SYSTEM FOR DESKS AND THE LIKE. Bent L. Weaver, Middletown, and William R. Miller, Penbrook, Pa., assignors to R. & W. Co. Filed Dec. 17, 1910. The sliding leaf of the desk has mounted in it a set of push buttons which are connected to their circuits by means of metallic bars on which the leaf slides.

1,003,740. SPARK PLUG. Otto H. H. Heins, Edgewater, N. J. Filed June 16, 1909. Has an open and a closed end, a pole piece extending through the closed end and suitably insulated therefrom, the pole piece bearing a terminal electrode in spark-producing relationship to the open end.

1,003,743. MEANS FOR STARTING INTERNAL-COMBUSTION ENGINES. Gottlob Honold, Stuttgart, Germany. Filed March 21, 1908. Combines with a plurality of igniters, a source of electrical energy arranged to supply current to the igniters, a positively-actuated circuit interrupter arranged to interrupt the supply of current to the igniters, a normally inoperative trembler circuit breaker arranged in parallel with the positively-actuated circuit breaker, and manually controlled means for rendering the trembler operative.



1,003,817.—BRUSH-HOLDER.

1,003,746. ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Co. Filed Jan. 28, 1909. An induction motor drives a direct-current generator, which supplies current to the lines and also to a local storage battery. Means are provided for varying the division of load between the battery and the generator, these means being responsive to load fluctuations on the motor.

1,003,747. ELECTRICAL SYSTEM OF DISTRIBUTION. Albert S. Hubbard, Belleville, N. J., assignor to Gould Storage Battery Co. Filed Dec. 10, 1909. Renewed July 8, 1911. Combines a main circuit, a battery connected across the circuit, a booster in series with the battery, an exciter in series with the booster field, a field coil for the exciter subject to variations in the electrical condition of the system and an opposing field coil for the exciter connected in series with the booster field.

1,003,799. PROCESS FOR THE ELECTROLYTIC DEPOSIT OF METALS. Armin Rodeck, Milan, Italy. Filed June 6, 1911. Consists in successively depositing given quantities of metal on one portion of a moving cathode; forming the desired article by simultaneously and successively plating out the same quantities of metal from another portion of the cathode; and in suitably moving the article relatively to the cathode during the plating operation.

1,003,817. BRUSH HOLDER FOR DYNAMOS. Charles H. Smoot, Chicago, Ill., assignor to Rateau Turbine Co., Chicago, Ill. Filed Dec. 14, 1906. A lever arm held by a stiff coiled spring pushes the brush against the commutator. A second spring maintains an even pressure against this stiff spring and the brush.

1,003,829. ELECTRICAL SYSTEM OF DISTRIBUTION. Edward Van Wagenen, New York, N. Y., assignor to Gould Storage Battery Co. Filed July 12, 1909. A booster is connected in series with the battery, an exciter supplying current to the

field windings. Field windings on the exciter are subject to variations of load on the circuit, other windings being connected across the booster armature and arranged to cut down the flux, produced by the first field windings both when the battery charges and when it discharges.

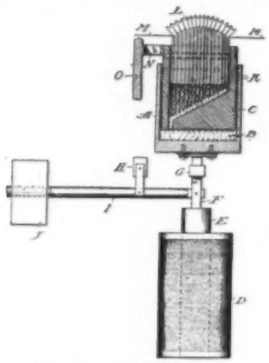
1,003,839. INDUCTION MOTOR. John B. Wiard, Lynn, Mass., assignor to General Electric Co. Filed May 10, 1909. An axially movable rotor has high and low resistance members, which are axially displaced from one another. The rotor is moved axially while the motor is coming up to speed, and is automatically returned when the motor stops.

1,003,860. SHADE HOLDER. Eric Anderson and George B. Thomas, Bridgeport, Conn., assignors to Bryant Electric Co., Bridgeport, Conn. Filed May 10, 1911. Has a support-gripping spring flange, a locking member and means for drawing down the locking member between said body and spring flange to lock the latter in engagement with its support.

1,003,862. HIGH-SPEED TROLLEY. Albert H. Armstrong, Schenectady, N. Y., assignor to General Electric Co. Filed Sept. 3, 1908. Pivoted arms extending from the periphery of the trolley wheel make contact with the trolley wire irrespective of its varying distance from the axis of the wheel.

1,003,881. TROLLEY. Frank Criest, Butler, Pa. Filed April 14, 1911. The trolley wheel turns on a curved journal pin, the axis of the wheel being flared at both ends to fit on any part of the pin.

1,003,882. ELECTRIC REGULATOR. Stuart Y. Culley, Covington, Ky. Filed Dec. 23, 1910. A reservoir containing mercury is moved up and down by the action of a solenoid. A stationary box immersed in the mercury is provided with a hole for admitting and releasing mercury. This box contains a series of contact fingers connected at their upper ends by resistances and dipping successively farther and farther into the mercury as the solenoid core rises.



1,003,882.—REGULATOR.

1,003,883. WATTMETER. Cecil R. D'Arcy, Wolston, near Coventry, England, assignor to General Electric Co. Filed Jan. 18, 1910. Relates to the details of a case and windings for a recording wattmeter.

1,003,890. TROLLEY AND TROLLEY-SUPPORT. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Co. Filed Aug. 21, 1908. The angular movement of the collector arm raises or lowers the carrier, by means of valves and pistons actuated by such movements.

1,003,902. THREE-POSITION SIGNAL. Laurence A. Hawkins, Schenectady, N. Y., assignor to General Electric Co. Filed Nov. 7, 1908. Comprises an electric motor, a driving member driven by the motor, a semaphore arm, means for clutching the member to the arm to drive it from danger to caution and to clear and to hold the arm at caution or at clear and for unclutching the arm to permit it to move from clear to caution and to danger.

1,003,906. RESILIENT TROLLEY-GUARD. John P. Hoffer, St. Louis, Mo. Filed April 26, 1911. The guard is attached to the pole by means of springs.

1,003,915. AUTOMATIC MOTOR-STARTER. Charles D. Knight, Schenectady, N. Y., assignor to General Electric Co. Filed June 10, 1907. Renewed April 3, 1909. Comprises a transformer, a plurality of magnetically operated switches for first connecting the motor to the supply circuit through the transformer and then connecting the motor directly to the supply circuit, and electrically controlled means for mechanically locking the switches in operative position.

1,003,919. DISTANCE CONTROL SYSTEM. Louis R. Krumm, Columbus, O. Filed Aug. 21, 1909. Motor-controlling devices are adopted to start and stop the motor in response to control by currents over one of two conductors connecting the switch elements to the devices. The speed of the motors may be changed within predetermined limits in response to control by currents over the other conductor.

1,003,923. METHOD OF MULTIPLE CONTROL. Harry Ward Leonard, New York, N. Y. Original application filed Jan. 24, 1901. Divided and this application filed May 9, 1901. A number of electrically operated vehicles are accelerated and decelerated in unison, alternating current for this purpose being controlled by means of a separate control circuit.

1,003,924. ELECTRICAL CONTROLLING MEANS. Harry Ward Leonard, Bronxville, N. Y. Filed July 12, 1905. Renewed Jan. 7, 1910. The combination of three or more supply mains, a source of gradually varying electromotive force for controlling a translating device, a translating device controlled thereby, and means for connecting said source in series with the device and to one of the supply mains and also in series across the supply mains.

1,003,925. METHOD AND MEANS FOR CONTROL OF ELECTRIC ENERGY. Harry Ward Leonard, Bronxville, N. Y. Filed Dec. 7, 1905. The combination of a plurality of sources of electromotive force having electromotive forces different in value from each other, electro-dynamic means for producing a variable and controllable electromotive force, an electric motor, and means for combining the electrodynamic means with each of the sources of electromotive force for controlling the motor.

1,003,926. METHOD AND MEANS FOR CONTROLLING ELECTRIC MOTORS. Harry Ward Leonard, Bronxville, N. Y. Filed March 16, 1906. Renewed July 13, 1911. A number of electric motors are arranged to drive a common load, current at different voltages being supplied. The speed is varied by means of these voltage changes.

1,003,927. MULTIPLE CONTROL SYSTEM. Harry Ward Leonard, Bronxville, N. Y. Original application filed Jan. 24, 1901. Divided and this application filed March 22, 1902. Renewed July 6, 1906. A system of three conductors, a source of constant electro-motive force connected between two of the conductors, the field winding of a dynamo electric machine connected between one of the two conductors and the third conductor, and means at two or more different points for connecting said third conductor with the other of the said two conductors.

1,003,954. ELECTRIC SWITCH. George B. Thomas, Bridgeport, Conn., assignor to Perkins Electric Switch Manufacturing Co., Bridgeport, Conn. Filed Feb. 3, 1910. Has a push button with push plate, a flange thereon serving as a detent, a switch member provided with a stop lug engaging the detent first on one side and then on the other.

1,003,955. DYNAMO. Louis E. Underwood, Lynn, Mass., assignor to General Electric Co. Filed Jan. 14, 1909. The combination of field coils and connections for producing a unidirectional initial field, an armature having a commutator revolving within the field, commutator brushes and connections feeding a circuit, and means revolving with the armature producing a polyphase short-circuit on the armature.

PATENTS THAT HAVE EXPIRED.

Following is a list of the electrical patents (issued by the United States Patent Office) that expired September 25, 1911:

528,184. ELECTRIC-ARC LAMP. Rudolph Segerdahl, Chicago, Ill.
528,188. ELECTRIC TRANSFORMER. Elihu Thomson, Lynn, Mass.
528,189. THERMOSTAT. David W. Thompson, Chicago, Ill.
528,204. ARMATURE FOR DYNAMO-ELECTRIC MACHINES AND METHOD OF MAKING SAME. Thomas H. Hicks, Detroit, Mich.
528,205. CONDUIT ELECTRIC RAILWAY. Julius L. Hornig, St. Louis, Mo.
528,241. ELECTRIC-LAMP SHADE. Edouard Vedovvelli, Paris, France.
528,245 and 528,246. ELECTRIC RAILWAY SIGNAL. Adoniram J. Wilson, Port Chester, N. Y.
528,291. UNDERGROUND CONDUIT. James F. Cummings, Detroit, Mich.
528,301. ART OF COATING ELECTRIC CONDUCTORS. Albert F. Montgomery, Lincoln, R. I.
528,330. CONDUIT SYSTEM FOR ELECTRIC RAILWAYS. John B. Linn, Cleveland, O.
528,379. CLOSED-CONDUIT ELECTRIC RAILWAY. James F. McLaughlin, Philadelphia, Pa.
528,430. ELECTRO-MAGNETIC SWITCH. John G. Hartel, Keokuk, Iowa.
528,438. SAFETY DEVICE FOR ELECTRIC CARS. John M. Kelly, Rochester, N. Y.
528,440. REVERSING MECHANISM FOR ELECTRIC MOTORS. John Mellen, Newport, Ky.
528,444. ELECTRIC SIGNALING APPARATUS FOR BLOCK SYSTEMS. Matthew S. Reiley, Washington, D. C.
528,445. SECONDARY BATTERY. John E. Rhette, Salem, Ind.
528,465. ELECTRIC MACHINE FOR RAILWAY SYSTEMS. Edward Deming, New York, N. Y.
528,477. SUPPLY SYSTEM FOR ELECTRIC RAILWAYS. Charles H. Harkins, St. Louis, Mo.
528,494. CLOSED CONDUIT FOR ELECTRIC RAILWAYS. William E. Stearns Berlin, Conn.